THE CIRRIPED FAUNA OF TROPICAL WEST AFRICA

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CONTENTS

SYNOPSIS

Sixty-nine species of Cirripedia are known from the tropical and warm-temperate waters of West Africa. This number includes littoral and shallow-water species and a very few from deep water. Further deep-water species, particularly of *Scalpellum* and *Verruca* may be expected when the deep basins off tropical West Africa are investigated more thoroughly. For this reason several species of Scalpellidae from the warm-temperate waters off north-west Africa, e.g. *Smilium longirostrum* (Gruvel) and *Scalpellum velutinum* Hoek, are included. The status of many rare or poorly recorded species requires further elucidation. The absence of the genus *Acasta* is remarkable.

The fauna contains elements from the north, *Scalpellum scalpellum* (L.) and *Chthamalus stellatus* (Poli) and from south-west Europe and the Mediterranean as would be expected from the published knowledge of the distribution of other groups of animals on this coast. Some of these species extend no farther south than Cape Verde, others extend to the south of the Gulf of Guinea. There is a very small South African component, of which *Chthamalus dentatus* Krauss is the most note-worthy. Four species, *Smilium renei* (Gruvel) *Chthamalus aestuarii* Stubbings, *Balanus pallidus* Darwin and *Chelonibia manati* Gruvel appear to be indigenous to tropical West Africa south of Cape Verde. The faunistic boundary in the region of Cape Verde noted by workers on other groups applies to many species of barnacle also.

I. INTRODUCTION

In considering the fauna of tropical West Africa it is appropriate to set limits to the region other than those imposed by the tropics of Cancer and Capricorn, to exclude those areas of coast, north and south, under the influence of the Canary and Benguela currents. Nicklès (1950) defined the " West Coast of Africa " for purposes of listing the Molluscan fauna, as the area between Cap Blanc in Mauretania and Mossamedes, Angola, that is approximately from 21° N. Lat. to 15° 30′ S. Lat. Longhurst (1962), reviewing the oceanography of the Gulf of Guinea has concluded that 14° N. and 14° S. Lat. present important faunistic boundaries corresponding to oceanographic frontal zones in these latitudes. These limits are in close agreement with those proposed by Ekman (1953) namely 15° N. and 15° S. (or possibly 16°–17° S.). This northern limit at 14–15° N. corresponds approximately to Cape Verde, Senegal, and there is evidence of a change of Cirriped fauna in this area, north temperate warm water

species giving place to sub-tropical or tropical forms. In the present work Longhurst's (1962) limits of 14° N. and 14° S. are regarded as defining the tropical coast of West Africa but species from both farther north and south, which it seems likely may occur within these latitudes, have been included.

There is adequate material available from several sources linking the West African tropical fauna with that of the Atlantic north temperate zone. To the southward there is still a gap in our knowledge due to the virtual absence of information from south west Africa. In consequence the extent to which South African species penetrate northwards towards Angola is uncertain.

Broch (1924) summarized knowledge of the west African shallow-water barnacle fauna to that date. Few species had been recorded and many of the records gave vague localities, e.g. " West Africa ". Later works added only a little new informatin, but exploration since 1945 has increased our knowledge greatly. The " Atlantide " expedition, " Calypso " expeditions to the Gulf of Guinea and to the Cape Verde Archipelago and the Belgian Atlantique Sud expedition have all contributed. In addition collections made by the Museum d'Afrique Centrale (Tervuren), the Institut Français d'Afrique Noire, Dakar and the, now defunct, West African Fisheries Research Institute, Sierra Leone have all contributed specimens.

The present work reports on an extensive collection made in Ghana by Mr. R. Bassindale in 1949–51 and on a smaller one made by the author in Nigeria in 1957–8. Unpublished West African material in the British Museum is included. In order to make this report fully representative of the Cirriped fauna of the region, all species recorded by previous authors are included, provided the records are considered valid. The few species not included individually appear under the synonymy of species with which they have been merged since the original publication of the record. The species and varieties omitted are as follows :

Chthamalus stellatus depressus: Nilsson-Cantell (1938), Gauld (1957), *C. cirratus:* Kolosvary (1941*b*, 1943*a*), *C. withersi:* and *C. rhizophorae:* Longhurst (1958) = *C. aestuarii* Stubbings.

Balanus amphitrite var. *hawaiiensis:* Stubbings (1963) and *B. amphitrite* var. *denticulata:* Stubbings (1961*a*) = *B. amphitrite amphitrite* Darwin.

B. dybowskii Gruvel (1903) and Broch (1924*a*), *B. amphitrite* var. *stutsburi* Darwin (1854) *et auct.*, *B. pallidus stutsburi:* Harding (1962) = *B. pallidus* Darwin.

B. dollfusi Broch (1927) and Nilsson-Cantell (1938, 1939*b*) = *B. spongicola* Brown.

B. occidentalis Stubbings (1961*a*, *b*) = *B. fallax* Broch.

It is probable that the littoral and shallow water Cirriped fauna of tropical Africa is now fairly well known and that few species remain to be discovered at least in the Lepadomorpha and Balanomorpha. There is still need for more information on the occurrence of the species of intermediate depths, i.e., of the continental shelf. The geographical range of *Scalpellum renei* Gruvel is uncertain and that of *Ibla atlantica* sp. n. virtually unknown. It is not improbable that intensive investigation of these intermediate depths will reveal further species.

Post-war investigations into the Acrothoracica have revealed several new West African species (Stubbings, 1961*b*, 1964*b*; Tomlinson, 1960) and there would appear to be a favourable field here for further work. The Ascothoracica have not been investigated so far. The considerable development of Zoanthid colonies in some areas, as on parts of the Ghana coast, would suggest the presence of these parasitic Cirripeds.

The deep-water fauna off the west coast of Africa has not been investigated to any extent. This is in marked contrast to the warm temperate region to the northward in which extensive work in the area of Madeira and the Azores has yielded many species notably of Scalpellum and Verruca (Aurivillius, 1898; Gruvel, 1900*a*, *b*). The German Tiefsee-Expedition made a number of stations down the coast in deep water from which which the deepwater *Scalpellids*, *Smilium longirostrum* and *Scalpellum trapezoideum*, were obtained (Weltner, 1922). As Gruvel (1905) could list 25 species of *Scalpellum* and 15 of *Verruca* from the northern warm temperate area it is probable that more species will be found when the deep waters of the Cape Verde, Sierra Leone, Guinea and Angola basins are worked systematically.

The following list of 70 species and varieties includes all those known to occur within the specified area plus a few that have been found outside it but may well be found there :

Mitella pollicipes (Gmelin)
Smilium longirostrum (Gruvel)
S. renei (Gruvel)
Scalpellum scalpellum (Linn.)
S. imperfectum Pilsbry
S. trapezoideum Hoek
S. velutinum Hoek
Ibla atlantica sp. n.
Lepas anatifera Linn.
L. anserifera Linn.
L. hillii Leach
L. fascicularis Ellis and Solander
L. pectinata Spengler
Heteralepas cornuta (Darwin)
Paralepas minuta (Philippi)
Conchoderma auritum (Linn.)
C. virgatum (Spengler)
C. virgatum var. *chelonophilum* Leach
Trilasmis (*Poecilasma*) *crassum* (Gray)
T. (*P.*) *kaempferi* (Darwin)
Octolasmis tridens (Aurivillius)
O. lowei (Darwin)
O. hoeki (Stebbing)
Verruca striata Gruvel
Chthamalus stellatus stellatus (Poli)
C. stellatus bisinuatus Pilsbry
C. dentatus Krauss
C. aestuarii Stubbings
C. fragilis Darwin
Pachylasma giganteum (Philippi)
Balanus (*Megabalanus*) *tintinnabulum tintinnabulum* Linn.
B. (*M.*) *tintinnabulum maroccana* Broch
B. (*M.*) *tintinnabulum zebra* Darwin
B. (*M.*) *tintinnabulum concinnus* Darwin
B. (*M.*) *tintinnabulum spinosus* (Gmelin)
B. (*M.*) *tulipiformis* Darwin
B. (*M.*) *nigrescens* Lamarck
B. (*M.*) *maxillaris* (Gronovius)
B. (*Balanus*) *trigonus* Darwin
B. (*B.*) *spongicola* Brown
B. (*B.*) *perforatus* Brug.
B. (*B.*) *perforatus* var. *angustus* Gmelin
B. (*B.*) *perforatus* var. *fistulosus* Poli
B. (*B.*) *eburneus* Gould
B. (*B.*) *improvisus* Darwin
B. (*B.*) *improvisus* var. *assimilis* Darwin
B. (*B.*) *amphitrite amphitrite* Darwin
B. (*B.*) *amphitrite albicostatus* Pilsbry
B. (*B.*) *pallidus* Darwin

B. (*B.*) *venustus venustus* Darwin
B. (*B.*) *venustus niveus* Darwin
B. (*Hesperibalanus*) *fallax* Broch
B. (*Conopea*) *calceolus* Darwin
Tetraclita divisa Nilsson-Cantell
T. purpurascens Wood
T. squamosa squamosa (Brug.)
Pyrgoma anglicum Sowerby
Chelonibia testudinaria Ellis
C. caretta Spengler
C. manati Gruvel
C. patula (Ranzani)
Coronula complanata (Mörch)
Platylepas hexastylos (O. Fabr.)
Stomatolepas elegans (O. G. Costa)
Xenobalanus globicipitis Steenstrup
Cryptophialus coronatus Tomlinson
C. variabilis Stubbings
Kochlorine hamata Noll
K. inermis Stubbings
Kochlorinopsis discoporellae gen. et. sp. n.

References under species synonymy have been reduced to as few as possible and are only given when the species is but little known, though originally described long ago, e.g. *Smilium renei* (Gruvel, 1902) or when the nomenclature is questioned or has been recently, e.g. *Chthamalus aestuarii* Stubbings, 1963. References to geographical distribution are given only in the text.

Locality citations for material reported here for the first time are arranged geographically according to country of origin from North Africa to the Cape. Mr. Bassindale carried out a large number of trawl and dredge hauls in a circumscribed area off Accra, Ghana, in addition to collecting at many named shore localities. The Accra stations are referred to here by their numbers. For full available details of these collecting stations reference should be made to Bassindale (1961).

Mr. Bassindale's material comprises the largest part of that described here. To avoid excessive repetition his name does not appear in the locality citations. Other sources of materials are distinguished by citation of the collecter's name and where appropriate the British Museum registration number. The author's own collections are followed by his initials (H.G.S.) with or without a serial collector's number as appropriate. Samples collected by the Staff of the Tropical Testing Establishment of the Ministry of Supply in 1953–4 are designated by the initials T.T.E.

The " dolphin " mentioned in some references to Port Harcourt, Nigeria, is a concrete structure erected in the river to aid in warping out ships from the quay but no longer used.

2. SYSTEMATIC ACCOUNT

LEPADOMORPHA

MITELLA

Mitella pollicipes (Gmelin)

Mitella pollicipes: Stubbings, 1965, 877.

Localities: Cape Verde Is.: (1) St. Vincent, coll. Mrs. M. G. Bannerman. (2 spec.) B.M. 1915.1.11.1–2. (2) coll. C. R. Stonor. B.M. 1939.7.22.9–13 (21 large and 6 small spec.).

The distribution of *M. pollicipes* is rather clearly defined. On the European Atlantic coast it is found from Finisterre to Spain and Portugal (Bishop *et al.*, 1957 ; Gruvel, 1920 ; Fischer-Piette & Prenant, 1956, 1957). In the Mediterranean, Llabador (1937) has established its occurrence on the Algerian coast from Algiers westward. From the northern shore there is a doubtful reference to the species from Nice (Caziot, 1921) based on a century-old record of Verany (1862) but it is not recorded from Banyuls (Utinomi, 1959*a*). Kolosvary (1940) records it from the Mediterranean without precise locality. Most recently Barnes & Barnes (1964 : 9) record it from Catalan Bay, Gibraltar. The textual name *polymerus* in this paper is a MS error (Auct. in litt.).

From Algeria it extends westward and southward on the African coastline and is found in suitable situations in Morocco, Rio de Oro, Mauretania and Senegal (Broch, 1927*a* ; Gruvel, 1912 ; Nilsson-Cantell, 1939*b* ; Stubbings 1965). Sourie (1954) states that it is well represented at Dakar and fairly common at Cap Blanc (Mauretania). He did not find it at Conakry, French Guinea and there seems no doubt that Dakar defines the southern limit of the species in West Africa.

From the Atlantic islands there are very few records. The above noted material in the British Museum confirms the presence of *M. pollicipes* in the Cape Verde archipelago. Its absence from the " Calypso " Cape Verde collections (Stubbings, 1964*a*) suggests, however, that it is not very common there. From the Canary Is. there are no recent records, but Darwin (1851) clearly handled material from Teneriffe. Its presence, or absence, in the Azores likewise needs elucidation. Weltner (1897) records specimens from " Portugal oder Acoren " but there is no certain record from these islands.

The inclusion of England, Scotland, Ireland, the North Sea and even Jan Mayen within the area of distribution of *M. pollicipes* (Darwin, 1851 ; Weltner, 1897 ; Gruvel, 1905) would seem highly improbable except for chance specimens on drift, an unusual habitat for the surf-loving *Mitella*. The Indonesian record of Tonkin (Gruvel, 1912) likewise is improbable.

Smilium renei (Gruvel)

Scalpellum renei Gruvel, 1902*b*, 229–233, pl. 12, figs. 5–7.
Scalpellum (*Smilium*) *renei:* Pilsbry, 1907, 13.
Smilium renei: Stubbings, 1961*a*, 9–11, text-fig. 1.
Smilium renei: Stubbings, 1961*b*, 181.

Locality : Ghana : Off Accra Sta. 72, 38m, on fine branches of an Alcyonarian (2 spec.).

One specimen measured, capitulum 3·0 mm., peduncle 1·5 mm., and the other capitulum 2·0 mm., peduncle 0·75 mm. These are small compared with Gruvel's type specimen which has capitular and peduncular lengths each 5·25 mm., and the largest Atlantide specimens which had a capitular length of about 7·0 mm.

The species has now been recorded from French Guinea, Ivory Coast, Ghana, Nigeria and Angola, thus establishing its presence as a shallow-water species throughout tropical West Africa from approximately 10° N. to 10° S. Lat.

Smilium longirostrum (Gruvel)

Weltner (1922) records this species in 2480 m. south of the Canary Islands, Lat. 24° 35′ N., Long 17° 4′ W., i.e., somewhat to the north of the area under discussion. It is thus a species that may be expected to occur in the deep water basins off tropical West Africa.

Scalpellum scalpellum (Linn.)

Localities: (1) Gambia, on carapace of the crab *Acanthocarpus africanus*, coll. A. R. Longhurst, B.M. 1956.1.7.1.(1 spec.); (2) Sierra Leone, W.A.F.R.I. sta. MB1/A4, on continental shelf 88 m., on a spine of *Cidaris cidaris meridionalis*, coll. A. R. Longhurst, B.M. 1956.4.27.1.(1 small spec.).

The southward distribution of *Sc. scalpellum* in coastal waters of the sub-tropical and tropical eastern Atlantic is now fully documented. It has been reported from the western Mediterranean (Utinomi, 1959*a*, *b*) and Adriatic (Broch, 1953*b*), Morocco and Rio de Oro (Broch, 1927*a*; Gruvel, 1902*a*), Canary Is. (Gruvel, 1920), Cape Verde Is. (Stubbings, 1964*a*), Senegal and Gambia (Stubbings, 1965), Sierra Leone (Stubbings, 1961*a*), Nigeria (Stubbings, 1961*b*), Gabon and the Congo estuary (Stubbings, 1963). This species is now known to have a vast range in latitude from Iceland and Lofoten, Norway (Lat. 68° N.) (Broch, 1924*c*) to the Congo (Lat. 6° S.).

Scalpellum imperfectum Pilsbry

Scalpellum imperfectum Pilsbry, 1907, 75–77, pl. 4, figs. 15–18, text-fig. 30.
Scalpellum imperfectum: Stubbings, 1961*a*, 11–13, text-fig. 2.

Not represented in the Ghanaian and Nigerian collections. The few records of this species indicate a very wide geographical range. In the Atlantic there are three records from eastern North America (Pilsbry, 1907), one from south of Iceland (Broch, 1953*a*), one from off Spanish Guinea (Stubbings, 1961*a*) and one from the Cape (Barnard, 1924). There is a further record from the Galapagos Is. (Macdonald, 1929).

Scalpellum trapezoideum Hoek

A single specimen of this species is recorded by Weltner (1922) from the Bight of Biafra in 2492 m. Lat. 2° N. Long. 8° 4′ E. It remains the single deep water species recorded from tropical West Africa as here defined.

Scalpellum velutinum Hoek

Scalpellum velutinum has not been found within the area but the " Talisman " took it in 882 m. off Pilones, Rio de Oro, as well as at two stations in Morocco and at Fuerteventura, Canary Islands (Gruvel, 1902*a*). It is, therefore, to be expected that *S. velutinum* will be found in the deep basins south of Cape Verde.

Ibla atlantica sp. n.

Locality : Sierra Leone : (1) W.A.F.R.I. Sta. MB1/B4, 08° 45′ N., 14° 38′ W., 220–440 m. (1 spec.) : Sta. MB1/B5, same position, 800 m. in burrows of *Pholadidea* prox. *loscombiana* Turton (Lamell., Pholadidae) (3 spec.).

Diagnosis : Unisexual : female with peduncle clothed in golden spines ; opercular valves golden brown with prominent growth ridges : no male organs : caudal appendages minute, one-segmented : cirri with numerous segments, increasing in number from C1 to C6. Male differentiated into peduncle and capitulum, attached to mantle wall by the antennae.

Type locality: as above, Guinea shelf off Sierra Leone, West Africa (see Longhurst, 1958, p. 73 and text-fig. 2). Holotype in British Museum B.M. 1956.4.27.3, a specimen with long peduncle from sta. MB1/B5: paratypes: 1) 2 other specimens from MB1/B5, one dissected registered number B.M. 1956.4.27.4. and slides reg. no. B.M. 1956.4.27.6 and 2) 1 specimen from sta. MB1/B4, reg. no. B.M. 1956.4.27.5.

Female : Valves golden brown with prominent growth ridges : scutum curved slightly towards tergum, the occludent margin slightly convex. Peduncle paler in colour, densely clothed in short golden hairs curved towards the valves. Length of peduncle variable, the lower portion narrowed and embedded in the wall of the mollusc burrow. Size 9·5 (5·0) mm. (MB1/B4) ; 14·5 (4·0) (Text-fig. 1*a*), 8·5 (3·5)

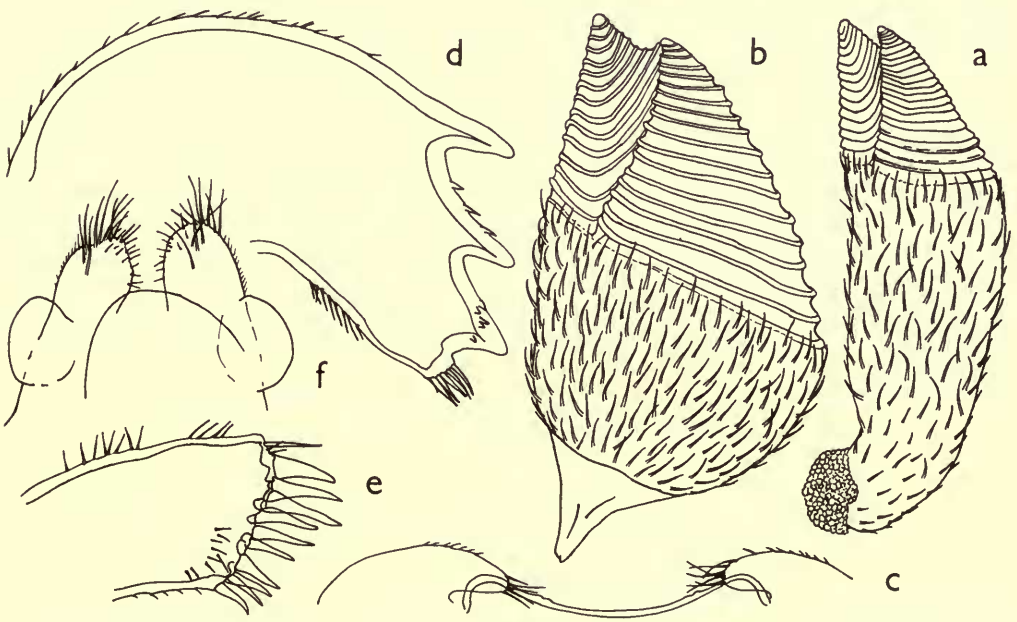

Fig. 1. *Ibla atlantica* sp. n. : *a*, type specimen, 14·5 mm. overall, with long peduncle (x c. 5) ; *b*, paratype, 8·5 mm. overall from same haul (×8·5) ; *c*, labrum (×47) ; *d*, mandible ; *e*, maxilla I (both ×135) ; *f*, paired maxilla II (×47).

(Text-fig. 1*b*) and 6·5 (3·0) mm. (MB1/B5) overall. Figures in brackets are the respective lengths of the valves.

Labrum (Text-fig. 1*c*) smoothly concave without teeth or hairs on margin. The palps are small, oval with a few short terminal setae. The mandible (Text-fig. 1*d*), bears denticles on the upper margin of the second and third teeth. The lower angle carries a tuft of short stout setae. The first maxilla (Text-fig. 1*e*) has a convex margin with ten stout spines. Maxilla II (Text-fig. 1*f*) has rather short terminal setae and very short setae on both inner and outer margins. The lower lobe is almost as large as the main lobe. The two appendages are set wide apart and there is a raised fold posterior to them " closing the gap " as described by Darwin.

The cirri have short segments rather broader than long near the base but elongating somewhat distally. There are one or two setae distally on the posterior margin. On the anterior margin each segment bears one pair of large setae distally with a single fine seta beside or between them. A smaller, often very small, pair of setae lies below the main pair. The number of segments in the cirri is high :

Cirrus	I	II	III	IV	V	VI
Segments	14·22	27·31	36·35	35·37	39·39	40·42

The caudal appendages are minute consisting of one oval lobe less than half the length of the pedicel of cirrus VI.

The mantle cavity contained nine minute individuals all apparently attached to the mantle wall, though six of them were early embryos. Two embryos had a single well-developed pigmented eye (? nauplii) and only one was recognizable as a young male probably recently metamorphosed as the single eye was still visible.

The male has clearly differentiated capitulum and peduncle and is attached by the antennae embedded in a mass of cement in the mantle wall. The black nauplius eye is still visible. The lobes of the cement gland are clearly visible within the capitulum and adjacent to the peduncle. The prosoma was poorly preserved and did not stain well. Little can be made out but an elongated slightly dumb-bell shaped structure, staining deeply probably represents the vesicula seminalis and male reproductive organs. The portion towards the base of the capitulum may be double, the two lobes lying one over the other, in which case two testes are present. This structure is obscured further by the presence of the cement gland. No valves are discernible.

Including *Ibla atlantica*, five species of *Ibla* are now recognized namely,

I. quadrivalvis Cuvier 1817
I. cumingi Darwin 1851
I. segmentata (Studer 1889)
  syn. *I. pygmaea* Broch 1922
I. idiotica Batham 1945
I. atlantica sp. n.

Two of these species, *I. quadrivalvis* and *I. segmentata* are hermaphrodite. *I. quadrivalvis* has extremely long caudal appendages composed of 32 segments and up

to three-quarters the length of the rami of cirrus VI. *I. segmentata* has fairly long caudal appendages of about 10 segments, longer than the pedicel of cirrus VI. Of the other three, female, forms without penis, only *I. cumingi* has long caudal appendages. *I. idiotica* resembles the new species in the minute caudal appendages, but differs in having only a few segments, up to 8, in the short rami of the cirri and in its very small size. There is no doubt that *I. atlantica* represents a new species of *Ibla*.

This is the first record of the genus from the Atlantic ocean. Although many records of *Ibla* spp. note the association with larger Cirripedia (Batham, 1945 ; Newman, 1960) this association has been shown not to be obligatory. The occurrence of Ibla in the burrows of an unrelated organism, as here, seems to be a hitherto unrecorded phenomenon.

Lepas anatifera Linn.

Lepas anatifera: Gauld, 1957, 10.
Lepas anatifera: Stubbings, 1961*a*, 13–14.

Not represented in the Ghanaian and Nigerian collections.

This species was collected from the hull of the Danish Expedition ship " Atlantide " at ports in Liberia, Ghana and Nigeria (Stubbings, 1961*a*). The duration of the ship's stay in West African waters, six weeks before the earliest of these collections, leaves no room for doubt that *L. anatifera* is present in those waters and was not brought from further north by the ship. There are few other records from the west coast. Gauld (1957) records this species from beaches in Ghana and Weltner (1897) specimens from the Cameroons. Evans (1958) has discussed the growth rate of specimens on the hull of " Petula " which must have settled in the vicinity of the Cape Verde Is.

From further north there are records by Gruvel (1920) and Broch (1927*a*) from Morocco. There are many records from the Azores (Gruvel, 1920). The British Museum has recent material from the Azores (B.M. 1955.9.2.2–3, coll. G. Chapman) and from Funchal, Madeira (B.M. 1954.9.15.4 coll. D. W. Tucker). *L. anatifera* is much less common on the West Coast than *L. anserifera* and from the greater number of records from more temperate waters it is possible that *L. anatifera* prefers rather lower temperatures than obtain in the tropical Eastern Atlantic.

Lepas anserifera Linn. 1767

Lepas anserifera : Gruvel 1912, 344–345.
Lepas anserifera : Broch 1924*a*, 202.
Lepas anserifera : Stubbings 1961*a*, 14 ; 1963, 4–5 ; 1964*a*, 104 ; 1964*b*, 330.

Localities: (1) Sierra Leone, on a floating plant stalk, —.2.55, coll. A. R. Longhurst, B.M. 1956.1.7.2 (28 almost full-grown spec.); (2) " off West Africa ", coll. A. R. Longhurst, B.M. 1957.6.3.2 (3 part-grown spec.).

Ghana: (1) Accra, on cuttlefish " bone ", 1935 coll. F. R. Irvine (5 spec.); (2) Takoradi, coll. Mrs. Carlyle Bell, B.M. 1948.1.17.1 (1 spec.); (3) Takoradi, on

floating seeds, 6.1.55, coll. D. T. Gauld (5 spec.); (4) Prampram, —.11.37, coll. Miss V. J. Foote, B.M. 1952.5.7.1 (many very small spec.); (5) Senegal, on *Sargassum* coll. Captain Moloney, B.M. 85–5 (9 small spec.).

Nigeria, Lagos: (1) on cuttlefish " bone " coll. Miss E. Trewavas, B.M. 1948.3.20.1 (27 nearly full grown spec. and some very small ones); (2) coll. Captain Moloney, B.M. 91.4.1.59–63 (10 large and 12 very small spec.).

Cameroons: (1) Off Fernando Po. coll. R. C. Ward, B.M. 1962.4.17.1 (34 spec.); (2) Debunscha Beach, Victoria, from a log 21.5.61, coll. J. T. Swarbrick, B.M. 1962.8.1.1 (about 90 spec. in small clusters).

Specimens in each of these collections have been checked for the possession of five filamentary appendages. The Debunscha beach specimens are of interest in respect of the very white shells with no bluish shadowing from the pigmented mantle and for the deep orange colour of the edge of the mantle.

In addition to the authors cited above, Weltner (1897) and Nilsson-Cantell (1921) record *L. anserifera* from the Cameroons. It is evidently the most widely distributed and frequently occurring species of *Lepas* in Tropical West Africa.

Weltner (1897) records " *L. pectinata* Spengler var. Darwin " from " West Africa " and Brian and Dartevelle (1954) record *L. pectinata* from Moita Seca at the mouth of the R. Congo. As reported elsewhere (Stubbings 1964*b*) I can find no *L. pectinata* in Dr. Dartevelle's material from Congo that I have examined all of which appears to be *L. anserifera*.

Lepas hillii (Leach) 1818

Locality: Ghana, Tenpobo: on cuttlefish " bone ", 1.2.50, coll. R.Bassindale (many small spec.).

These specimens, preserved in Bouins fluid, were completely decalcified and spoiled. From the presence of three filamentary appendages, a pair at the base of cirrus I and a single one on the prosoma, and apparently a gap between carina and scutum, they have been referred to *L. hillii*.

The above specimens appear to be the only ones recorded from the West African *coast*. Evans (1958) recorded them on the hull of " Petula " and deduced that they must have settled there shortly after the vessel left Dakar. They may be presumed to have settled during the voyage between that port and the Cape Verde Is. Hoek's (1883) specimens taken from the screw of H.M.S. " Challenger " at St. Vincent, Cape Verde Is. and those removed from " Atlantide " in Le Havre (Stubbings, 1961*a*) have a less certain provenance. Specimens have been taken off Morocco (Aguilar-Amat, 1927) and at Tangier (Gruvel, 1912) and many off the Azores (Gruvel, 1907*b*, 1920) and in the W. Mediterranean (Utinomi, 1959*a*). *L. hillii* is thus distributed over the eastern tropical and sub-tropical North Atlantic, but evidently rather few specimens occur in-shore. It is not represented in the collections of the Institut Français d'Afrique Noire in Dakar or in those of the Musée Royal de l'Afrique Centrale, Tervuren.

Lepas pectinata Spengler

non *Lepas pectinata*: Brian & Dartevelle 1954, 150.

There is no reliable evidence of the occurrence of *Lepas pectinata* on the tropical West African coast. The only precise record in the literature is that of Brian and Dartevelle (1954) from the Congo estuary which the author has given reasons for referring to *L. anserifera* (Stubbings 1964*b*). Weltner (1897) recorded the " var. Darwin " from W. Africa without precise locality. Further, Gruvel (1907*a*) recorded the species from " West of the coast of Guinea " and (1910) gave the same locality statement and also Porto Grande, St. Vincent, C. Verde Archipelago. The author has seen no material in the several collections handled that is referrable to *L. pectinata* and so considers it at best a doubtfully West African form. In 1966 R.R.S. " Discovery " took some recently metamorphosed *Lepas* off Fuerteventura, Canary Islands. These can be assigned with some degree of confidence to *L. pectinata*. Thus, after a lapse of over 50 years reliable *L. pectinata* material has been obtained from the eastern Atlantic. There is a reasonable possibility, therefore, that it will be found sooner or later in inshore or estuarine waters of tropical West Africa.

Lepas fascicularis Ellis and Solander

Not represented in the Ghanaian and Nigerian collections.

The paucity of records of *L. fascicularis* from the west coast has been noted (Stubbings, 1965). That so few specimens are contained in the Institut Français d'Afrique Noire, in Dakar can only indicate its infrequent occurrence in the Senegal area. Its scarcity on the Ghana coast and off Sierra Leone must be presumed for the same reasons. It has been recorded once from Morocco (Broch, 1927*a*) and once west of the Canary Islands (Gruvel, 1920). Available evidence thus suggests that *L. fascicularis* is not common on the north-west coast or west coast north of the equator. Its apparent abundance off the Congo estuary (Stubbings, 1963) is in complete contrast.

Heteralepas cornuta (Darwin)

Not represented in the Ghanaian and Nigerian collections.

The distribution of *H. cornuta* is still very imperfectly known. The records given by Broch (1927*a*) and Stubbings (1964*a*, 1965) suggest that it is present over a wide area of the north-western part of the coast of West Africa from the mouth of the Mediterranean to Cape Verde and the Cape Verde Archipelago. As it was not represented in collections from Ghana, Nigeria, the Gulf of Guinea, the Congo estuary and Angola it may well be that it is absent south of Cape Verde. This, however, would be surprising in view of its occurrence much further afield in the West Indies (Darwin, 1851) and the Andaman Sea (Nilsson-Cantell, 1938*a*). *H. cornuta* is apparently a deep-water species, all records being from below 100 m. and one at least from 750 m., so the lack of records from the tropical and southern sub-tropical coasts of West Africa may be due to the comparatively small number of deep-water collections so far made there.

Paralepas minuta (Philippi)

Locality : Sierra Leone : (1), W.A.F.R.I. Sta. MBI/A5, 132 m., 22.2.56, from near base of primary spines of *Cidaris cidaris meridionalis* B.M. 1956.4.27.2 : (2) the same, B.M. 1956.4.27.2A. (33 juv. spec.).

The recorded localities for *P. minuta* were listed by Stubbings (1961*b*). It occurs from Sicily in the central Mediterranean westwards to Gibraltar and down the African coast as far as Liberia (4° 40′ N.), the most southerly record being that made by the " Gazelle " (Studer, 1882, 1889). According to Broch (1927*a*) it occurs also in Madeira. The geographical distribution of *P. minuta* off north-west Africa is, therefore, somewhat greater than that of *H. cornuta* which is as yet unknown from the Mediterranean or from south of Cape Verde.

Conchoderma auritum (Linn.)

Not represented in the Ghanaian or Nigerian collections, *C. auritum* has been recorded from West African waters by Gruvel (1910), Weltner (1922), Kolosvary (1943*a*) and Stubbings (1961*a*). Three of these reports record material from a ship's hull, the fourth (Kolosvary, 1943*a*) from a whale. Where precisely in tropical Atlantic waters settlement occurred cannot be determined. Broch (1924*a*, 1927*a*) summarized the then known occurrence of the species in the tropical and sub-tropical Atlantic but added no new localities. As there are records from the Mediterranean (Monod, 1938 ; Nilsson-Cantell, 1932*a*) and South Africa (Barnard, 1924 ; Nilsson-Cantell, 1930*a*) and from off-shore West African waters (Weltner, 1887) a general distribution of this pelagic species in warm-temperate and tropical eastern Atlantic waters may be presumed.

Conchoderma virgatum (Spengler)

Locality : Madeira, Funchal, 12 juv., Aug. 1953, coll. D. W. Tucker, B.M. 1954.9.15.2 (12 juv. spec.). Not represented in the collections from Ghana and Nigeria.

Records of this cosmopolitan species refer almost entirely to specimens recovered from the hulls of ships either in tropical or warm temperate waters or shortly after moving into cooler waters. The major exception is that series of specimens collected mainly from fishes at Gorée, Senegal in the collection of I.F.A.N., Dakar (Stubbings, 1965).

Records north of the equator range from 2° N. (Nilsson-Cantell, 1930*a*) to nearly 42° N. (Gruvel, 1920). South of the equator there are fewer records except for South Africa (Barnard, 1924, 1925). It may be expected anywhere off the West African coast where flotsam comes ashore or craft are moored or ply for long periods in warm waters.

var. *chelonophilum* Leach

Not represented in the collections from West Africa.

There are a number of records from the Atlantic in Lat. 30°–40° N. (Hoek, 1883 ; Leach, 1818 ; Weltner, 1897 ; Gruvel, 1920) and Chevreux and de Guerne (1893) have recorded it from the western Mediterranean. The specimens reported by

Stubbings (1961*a*) were very small and could also have come from these warm temperate waters and not from tropical West African waters. Accordingly, the presence of this variety in West African waters requires confirmation.

Trilasmis (Poecilasma) crassum (Gray)

Weltner (1922) records this species from Grosse Fischbai (= Tiger Bay), Angola. As it was originally described from Madeira (Darwin, 1851) it is conceivable that it may yet be found within the report area.

Trilasmis (Poecilasma) kaempferi (Darwin)

Not represented in the Ghanaian and Nigerian collections.

There are numerous records of this species from the warmer North Atlantic, particularly from the region of the Azores (Gruvel, 1902*b*, 1920). It is also known from Madeira (Darwin, 1854, Weltner, 1897). From the West Coast of Africa there are comparatively few records: from Cape Bojador, Morocco (Gruvel, 1902*a*), Senegal (Stubbings, 1965); Spanish Guinea (Stubbings, 1961*a*) and in the South Atlantic from Grosse Fischbai (Weltner, 1922). Barnard (1924) records the species from Cape Point and off the Buffalo River, South Africa. *T.* (*P.*) *kaempferi* is therefore widely distributed in the eastern Atlantic at depths of 100 to 1,500 m. and can be expected off the West African coast wherever local conditions are favourable.

Octolasmis tridens (Aurivillius)

The only record of this species from West Africa is that from the Cape Verde Islands collected by the Danish "Atlantide" Expedition (Stubbings, 1961*a*). About 100 specimens of *O. tridens* were found on that occasion on a single Palinurid crawfish, yet no other specimens seem to have been collected from either the Islands or the African mainland.

Octolasmis lowei (Darwin) 1851

Localities: Mauretania: Cap Blanc, on gills of a crab, coll. M.H. Routh, B.M. 1952.10.2.7 (many spec.).

Ghana: (1) Accra, on the Crab *Callinects gladiator* coll. D. J. Gauld (28 spec.); (2) off Chorkor, on gills and in branchial chamber of the crab *Apiomithrax bocagei* (Osorio) (numerous spec.); (3) off Chorkor, in branchial cavity of *Calappa rubroguttata* Herklots (1 spec.).

The largest Ghanaian specimen had a capitular length of 2·5 mm. and a peduncle of 3·0 mm. A number contained developing eggs. The species was described by Darwin from Madeira and is recorded by Broch (1924*b*) from Mauretania and by Brian & Dartevelle (1954) from Luanda, Angola. It is evidently distributed over both the tropical and subtropical West African coast-line.

Gauld (1957) records *D. lowei* from *Callinectes gladiator* and has found it also on species of *Neptunus, Cronius, Micropisa, Dromia* and *Palinurus* (Buchanan, 1958: 23). Brian & Dartevelle (1954) cite also *Echinoplax* and *Maia*. The presence of a single specimen of *O. lowei* in the branchial space of *Calappa rubroguttata* is noteworthy as Gauld states that this crab is the only one examined by him in large num-

bers without finding this cirripede. A number of *Callinectes* collected at Port Harcourt were quite free from *Octolasmis*, perhaps due to the lowered salinity, which may fall to only 12‰ in the wet season.

Octolasmis hoeki (Stebbing)

Dichelaspis hoeki Stebbing, 1895, 18–19, pl. II, figs. A–D.
non *Dichelaspis antiguae* Stebbing, 1895, 19–20, pl. II, figs. E–G.
Octolasmis hoeki: Nilsson-Cantell, 1927, 763–6, text-fig. 9.

Locality : Ghana, Tema ; on *Scyllarides* sp. 2.9.59, coll. D. T. Gauld (11 spec.).

A suggestion from Mr. W. A. Newman of the Scripps Institution to the effect that some *O. hoeki* from Cape Verde Is. (Stubbings, 1964*a*) were probably not this species on the grounds of differences in mouth appendages, prompted a re-examination of Stebbing's types of *D. hoeki* and *D. antiguae*. Stebbing (1895) described the two species from material from Antigua, W.I., and listed a number of points in which they differed, both in valve form and internal morphology. His figures are, unfortunately, inadequate. Annandale (1910 : 217) studying further West Indian material admitted the occurrence of these differences, but found they were not correlated one with the other and united Stebbing's two species under *D. hoeki* which has page priority. Nilsson-Cantell (1927) was of the opinion that too much emphasis had been laid on differences in valve form in *Octolasmis* and followed Annandale, at the same time including *D. aurivillii* (Gruvel, 1902*b*) as a further synonym. He did not consider the differences in number of segments in the cirri of the two forms to be significant. Neither were the even smaller differences in caudal appendages considered of sufficient importance to justify the maintenance of the three species. Nilsson-Cantell (1927) does not mention the difference in setation of the segments noted by Stebbing. This was unfortunate as there seems here to be a constant difference between *O. hoeki* and *O. antiguae*.

In order to clarify the position, specimens variously named *Dichelaspis*, or *Octolasmis*, *hoeki* and *antiguae* from the West Indies, Cape Verde Islands and West Africa have been examined. They are referable to one species or the other and will be discussed below under these two species headings.

Materials examined : Tema, Ghana, W. Africa, coll. D. T. Gauld ; Cape Verde Islands (" Calypso " Exped. 1959 : Stubbings 1964*a*) ; Cape Verde Islands (B.M. 79–10 : publ. Nilsson-Cantell 1927) ; Dry Tortugas, W. Indies (B.M. 1952.6.10.2) ; Antigua, W. Indies (B.M. 1928.12.1.2988–2993, syntypes).

The shape of the opercular plates has been considered in some detail by Nilsson-Cantell (1927). He concluded that the differences between scutum and tergum in *O. hoeki* and in *O. antiguae*, described by Stebbing, were merely variations associated with age. The shape of these valves does, undoubtedly, vary with age as does also the proportion of the capitulum covered by the valves. Text-fig. 3 shows the scutum and tergum of a series of specimens of increasing capitular length from 2·03 to 3·44 mm. from Tema, Ghana. The gap between base of tergum and scutum becomes proportionately greater as the capitulum increases in size. The Cape Verde material (B.M. 79–10) shows a similar proportional reduction in the area covered by the valves.

Particular regard should be paid to the shape of the tergum (Text-figs. 2*a*, 3).

Owing to the deep emargination of the scutal margin of the tergum to accommodate the occludent lobe of the scutum the basi-occludent angle of the tergum has a "hooked" or "beaked" appearance. Also, the portion of the scutal margin opposite the basal segment of the scutum is marked off distinctly from the remainder so that a distinct corner is produced on the valve at this point. This angle is marked equally clearly in young and old specimens. The sharpness of the angle varies considerably.

The appendages have been compared in specimens from Stebbing's syntypes (Text-fig. 2*b–e*), from Tema (Text-fig. 4*a–e*) from the Cape Verde Islands and from the Tortugas. These may be compared with the published illustrations of the Cape

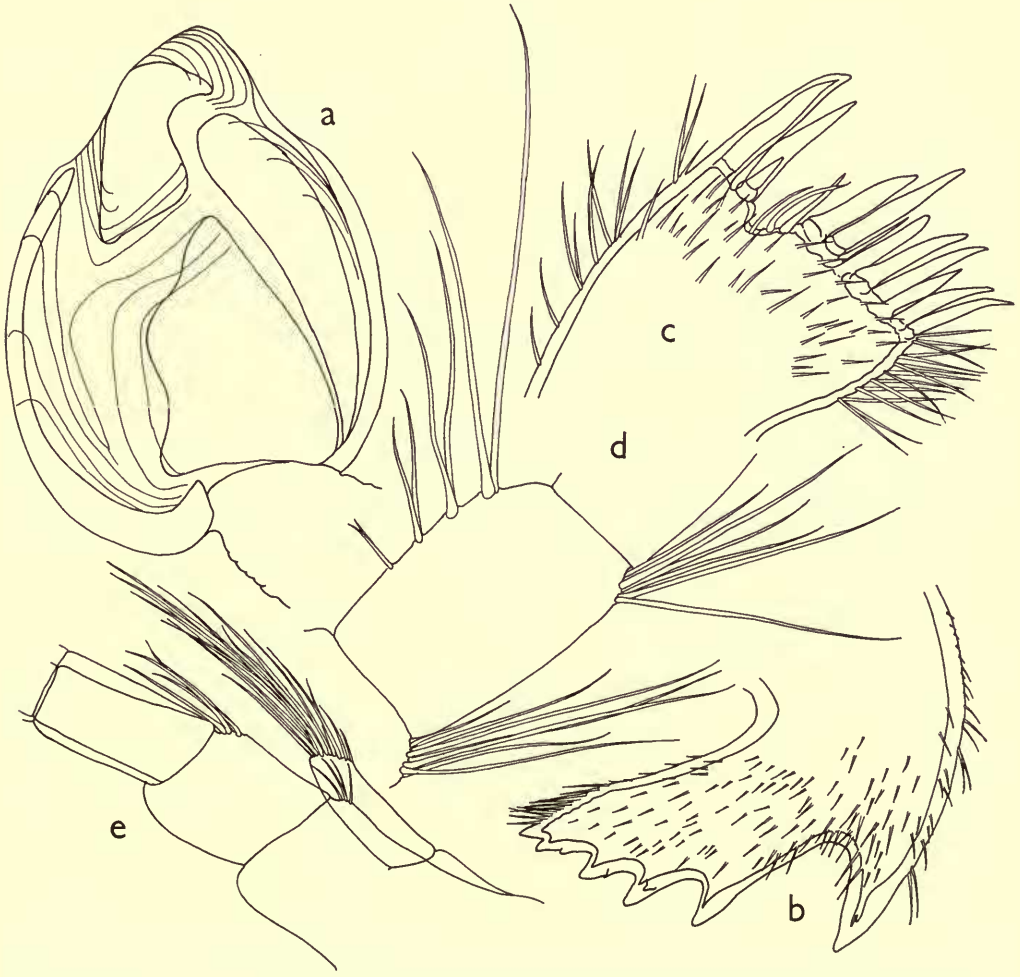

FIG. 2. *Octolasmis hoeki* (Stebbing) : syntype (B.M. 1928.12.1) : *a*, whole animal (×20) ; *b*, mandible (×183) ; *c*, maxilla I (×300) ; *d*, segment 4 of posterior ramus of cirrus VI (×205) ; *e*, base of cirrus VI and caudal appendages (×100).

Verde material (Nilsson-Cantell, 1927) and the author (1964*a*) and also with Stebbing's (1895) rather inadequate figures. They are all very similar and referable to the same species, *O. hoeki* (Stebbing). The following points are noteworthy : The mandible (Text-figs. 2*b*, 4*a*) has fourteeth, the third and fourth, and sometimes the second, with a subsidiary cusp. The lower angle is produced into two acute teeth, the upper of which has a subsidiary cusp. All the subsidiary cusps are weakly developed. The first maxilla (Text-figs. 2*c*, 4*b*) has two large spines above the notch with a third

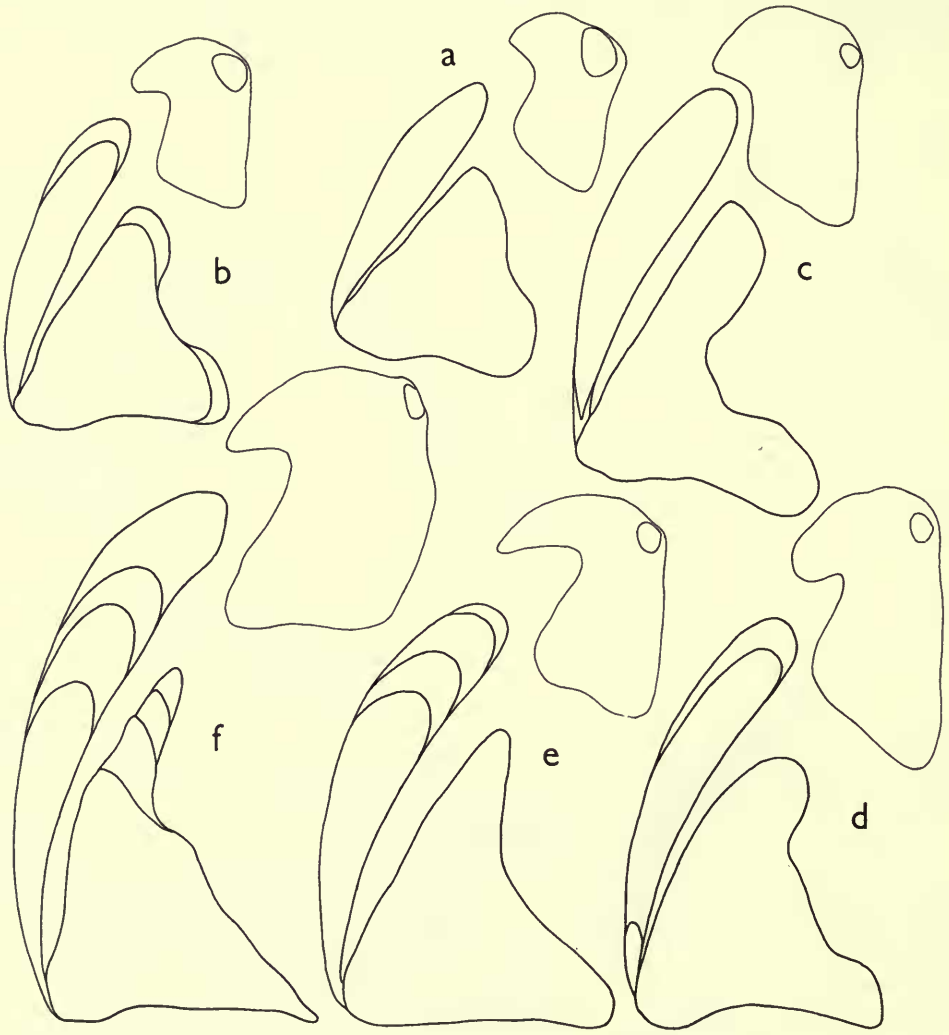

FIG. 3. *Octolasmis hoeki* (Stebbing) : right scutum and tergum of specimens of increasing size from Tema, Ghana to show change in shape of valves and in proportion of capitulum covered : capitular lengths *a*, 2·03 mm., *b*, 2·09 mm., *c*, 2·71 mm., *d*, 2·89 mm., *e*, 3·01 mm., *f*, 3·44 mm.

smaller spine lateral to the second spine. This third spine has not been reported hitherto. The notch is distinct and fairly deep. About three stout setae project from the notch. The lower part of the maxilla stands a little forward of the upper part. It bears a variable number of stout spines, eight or nine in those figured. Nilsson-Cantell (1927, Text-fig. 9*c*) shows only six. The second maxilla (Text-fig. 4*c*) is rounded with the front edge more or less flattened with spines along the whole border, as described and figured by Nilsson-Cantell (1927, Text-fig. 9*d*).

The number of segments in cirri II–VI varies between 8 and 12, the average falling between 9 and 10 for both rami. The numbers found in specimens from several localities and reported in the literature or newly examined are presented in Table 1.

TABLE 1

Source	I	II	III	IV	V	VI
Antigua, Stebbing 1894	6 or 7	←———	8–10	———	→	8
,, syntypes (B.M. 1928.12.1.2988–2993) new preparation	6·6	9·9	8·9	10·9	9·10	9·8
Tortugas (B.M. 1952.6.10.2)	6·6	10·10	10·10	10·10	11·10	10·11
Cape Verde Is. (B.M. 79–10)	6·7	9·9	9·9	9·9	9·9	9·10
Nilsson-Cantell (1927)	6·8	9·9	9·10	9·9	9·10	–·10
Cape Verde Is. new preparation	6·7	11·10	7+·10	8·10	9·10	12·11
,, ,, Calypso Exped. 1959 (Stubbings 1964*a*)	6·7	11·10	11·11	12·12	12·12	10·11
Tema, Ghana, D. T. Gauld 2.9.59	6·6	9·9	7+·9	8·10	8·9	9·10

TABLE 1. Number of segments in the rami of the six cirri in specimens of *O. hoeki* from various sources.

The individual segments are less than twice as long as broad (Text-figs. 2*d*, 4*d*), sometimes longer by as little as a fifth only. The ratio of length to breadth of segments from cirri of a number of specimens of *O. hoeki* are given in Table 2, together with similar figures for *O. antiguae* :

TABLE 2

Species and source	No. of pairs of setae per segment	L/Br.
O. hoeki		
B.M. 1928.12.1.2988–2993 syntypes (Text-fig. 2*d*)	4	1·50
B.M. 1952.6.10.2 Tortugas	4	1·83
B.M. 79–10 Cape Verde	4	1·58
Calypso Cape Verde	3	1·21
Tema, Ghana (Text-fig. 4*d*)	3	1·41
		$\overline{m}$ = 1·51
O. antiguae		
D. antiguae syntype (Text-fig. 6*f*)	6	3·0
B.M. 1952.2.14.1 Georgetown (Fig. 7*c*)	8	3·22
B.M. 1951.7.2.6 ,,	6	2·15
		$\overline{m}$ = 2·79

TABLE 2. Number of pairs of setae on segments of the posterior cirri and length/breadth ratio in these segments in *O. hoeki* and *O. antiguae*.

The number of pairs of setae on each segment of the posterior cirri is three or four.

The caudal appendage is variable in length and in the length of its setae. It may not reach to the distal end of segment 1 of the protopodite of cirrus VI, as in a Tortugas specimen or may extend some way along the second segment as in the syntype (Text-fig. 2*e*), the Tema specimen (Text-fig. 4*e*) and a Cape Verde specimen (B.M. 79–10). The setae may reach to the distal end of segment 1 of the rami of cirrus VI (syntype) or scarcely to the base of that segment (Tortugas specimen). Stebbing was probably right in adducing this as a point of distinction from his *D. antiguae* as in the latter the setae do seem to be consistently longer (see Text-figs. 5*g*, 7*d*) but the character is not constant in *O. hoeki*.

The penis is of moderate length and tapers to a rounded tip. It is sparsely covered with soft hairlike setae arranged in rather diffuse rows. The tip bears a

FIG. 4. *Octolasmis hoeki* (Stebbing) : appendages of a specimen from Tema, Ghana ; *a*, mandible ; *b*, maxilla I (both ×300) ; *c*, maxilla II ; *d*, segment 6 of anterior ramus of cirrus VI ; *e*, base of cirrus VI and caudal appendage (all ×183).

terminal tuft of rather stouter and longer soft setae. There is no terminal languet as in, for example, *O. lowei*. In several specimens examined, from different localities, the penis was of uniform width tapering toward the distal extremity. There was no widening of the middle portion as noted by Stebbing. This presumed character in two of Stebbing's specimens may be regarded as fortuitous and due to the state of contraction when preserved.

Octolasmis antiguae (Stebbing)

Dichelaspis antiguae Stebbing 1895, 19–20, pl. 2, figs. E–G.

MATERIALS EXAMINED : *Dichelaspis antiguae* Stebbing syntype, from Antigua, W.I. (B.M. 1928.12.1.2985–2987); *D. antiguae*, from Georgetown, Br. Guiana, (B.M. 1951.7.2.6); *D. antiguae* from Georgetown, Br. Guiana, (B.M. 1952.2.14.1).

Not known from the West African Cirriped fauna.

Stebbing (1895) separated *D. antiguae* from *D. hoeki* on the basis of the larger proportion of the capitulum covered by the valves, the contraction instead of widening of the tergum below, the slight emargination of the base of the carina and several characters of the appendages. The cirri were said to be more elongate than in *D. hoeki* and to have from 12 to 14 segments in all except the first pair; the segments being more slender and elongate and with more numerous spines. The caudal appendages also were said to be larger and more slender with longer terminal setae.

Outline drawings of scutum and tergum of British Guiana specimens are shown in Text-fig. 5 (B.M. 1952.2.14.1) from which the shape of these valves at different ages is apparent. The downward prolongation of the tergum noted by Stebbing is well seen in these figures of specimens in which the capitulum was well covered by scutum and tergum. The scutal border of the tergum is much straighter than in *O. hoeki* and in consequence the hook-like occludent lobe to the valve seen in that species is absent or at the most poorly developed. Furthermore the scutal margin becomes straighter with age.

If specimens of similar size are compared, e.g., Text-figs. 3*a*, 5*c* or Text-figs. 3*c*, 5*f*, the difference in tergal form between the two species will be apparent. *O. antiguae* appears to be rather smaller than *O. hoeki*. The greatest capitular length found was 3·44 mm. for *O. hoeki* but only 2·79 mm. for *O. antiguae*.

The labrum (Text-fig. 6*a*, syntype) has a series of well-developed teeth. The palp is oval and tapers slightly (Text-fig. 6*b* syntype). The mandible (Text-figs. 6*c*, 7*a*) resembles that of *O. hoeki* closely but the fourth tooth and the lower angle have more strongly developed subsidiary cusps. The maxilla (Text-figs. 6*d*, 7*b*) also resembles that of *O. hoeki*. The lower part of the biting edge is almost in line with that above the notch (Text-figs. 6*d* syntype and B.M. 1951.7.2.6) whereas in *O. hoeki* (Text-fig. 2*c*) the lower portion projects somewhat. This character again is not entirely reliable diagnostically as the lower angle may project in *O. antiguae* as shown in Text-fig. 7*b* (B.M. 1952.2.14.1). The second maxilla (Text-fig. 6*e*, syntype) is square and shows no distinguishing characters.

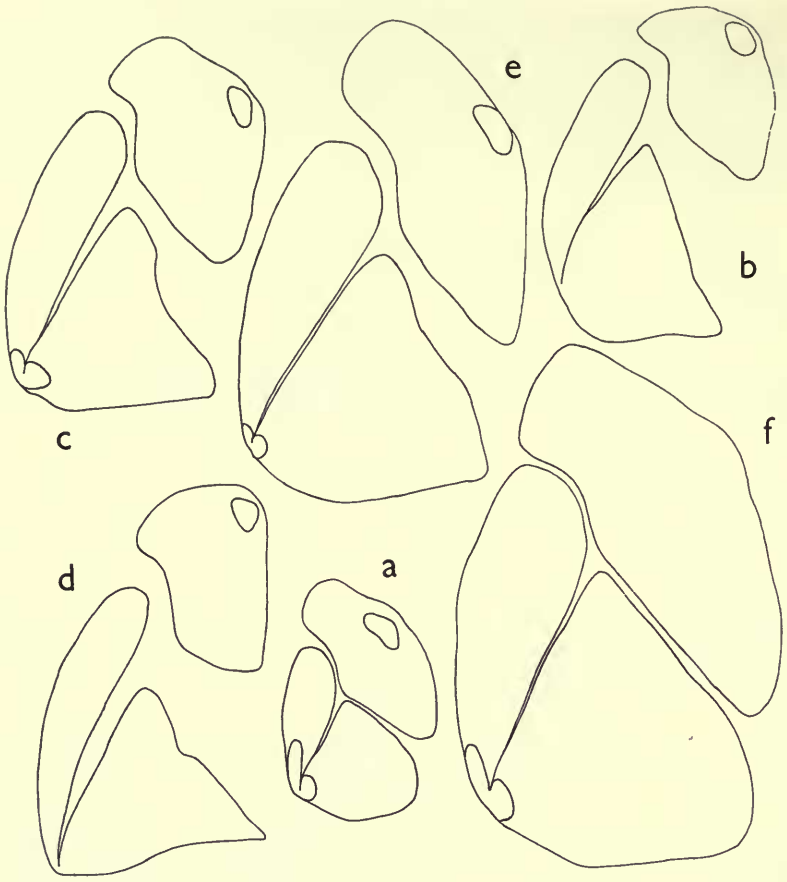

FIG. 5. *Octolasmis antiguae* (Stebbing) from Georgetown, British Guiana (B.M. 1952. 2.14.1): right scutum and tergum of specimens of increasing size showing greater coverage of capitulum and more elongated shape of tergum: for comparison with similar valves of *O. hoeki* shown in Fig. 3: capitular lengths *a*, 1·24 mm., *b*, 1·92 mm., *c*, 1·98 mm., *d*, 2·16 mm., *e*, 2·54 mm., *f*, 2·79 mm.

Re-examination of the cirri supports Stebbing's statement that they have more segments than do those of *O. hoeki*. The numbers found or recorded previously are shown in Table 3.

TABLE 3

	I	II	III	IV	V	VI
Stebbing 1895	7 or 8	←———		12–14		———→
D. antiguae syntype	—	—	—	—	—	14·10
B.M. 1952.2.14.1 Georgetown	6·7	12·11	12·12	12·12	12·12	11·10
B.M. 1951.7.2.6 ,,	6·7	12·11	10·12	12·14	11·13	10+·13

TABLE 3. Number of segments in the cirri of four *O. antiguae* including Stebbing's original statement (1895) and those in a syntype.

The mean number of segments in cirri II–VI is nearly 12. As Table 2 shows the length/breadth ratio of individual segments is much greater than in *O. hoeki*, being more than 2 and often more than 3. The number of pairs of setae is consistently higher at 6–8 pairs per segment.

The single-jointed caudal appendage may extend to just beyond the distal end of the first segment of the pedicel of cirrus VI (Text-fig. 6*g*, 7*d*) or may be a little shorter. In this it does not differ clearly from the condition in *O. hoeki*. The terminal setae are appreciably longer as normally they extend to the distal end of segment 1 of the rami and often appreciably on to the second segment.

The penis is of moderate length, tapers towards the tip and has sparse hairs along its length and a terminal tuft of rather longer hair-like setae. It does not differ from that of *O. hoeki*.

It would appear, therefore, that the differences between *D. hoeki* and *D. antiguae* originally described by Stebbing (1895) and now re-examined are distinguishable. They are not so strongly marked that variability within the two species cannot bring

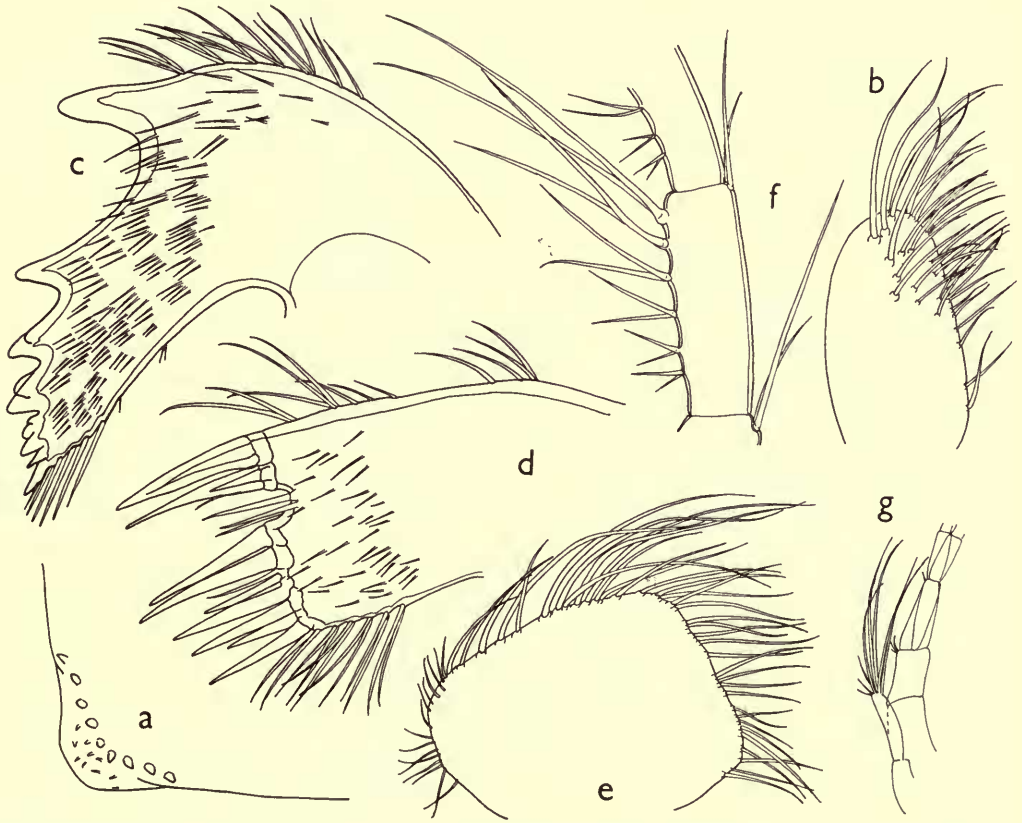

FIG. 6. *Octolasmis antiguae* (Stebbing): appendages of a syntype (B.M.): *a*, labrum; *b*, palp (both ×206); *c*, mandible (×294); *d*, maxilla I (×397); *e*, maxilla II; *f*, segment 7 of anterior ramus of cirrus VI (both ×206); *g*, lower part of cirrus VI and caudal appendage (×45).

about an overlap of individual characters. In consequence characters such as the shape of the tergum, the degree of dentation of the lower angle of the mandible, the straight or stepped edge of the maxilla and the length of the caudal appendage and its setae are individually unreliable as diagnostic characters. Taken collectively or when a series of specimens is available from the same source they afford a reasonably accurate guide to the species. The most reliable features are undoubtedly the proportions and setation of the cirral segments. In *O. hoeki* the length of the segments is less than twice the breadth and there are three or four pairs of setae. In *O. antiguae* the segments are more than twice, often over three times, as long as broad and there are from six to eight pairs of setae. These characters do not intergrade. Accordingly *Dichelaspis antiguae* Stebbing, 1895, is reinstated as a distinct species under the modern name *Octolasmis antiguae* (Stebbing, 1895).

The present investigation has shown that *O. hoeki* occurs on both sides of the tropical Atlantic whereas *O. antiguae* is known only from the much more restricted area of the Leeward Islands and British Guiana.

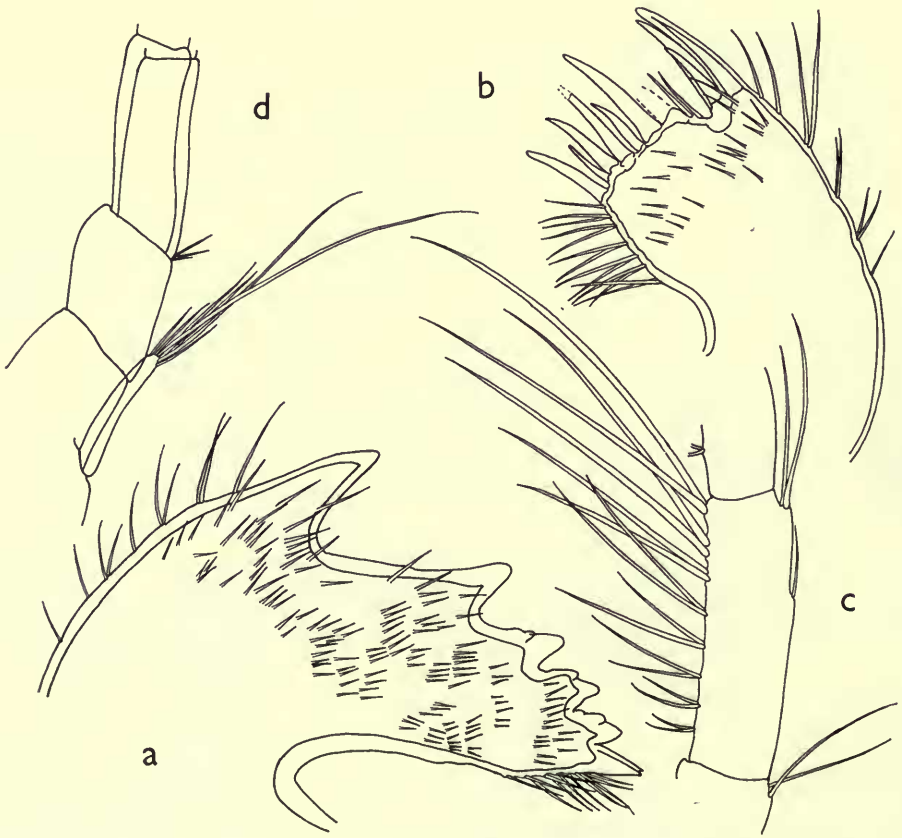

FIG. 7. *Octolasmis antiguae* (Stebbing) : Appendages of a specimen from Georgetown, British Guiana (B.M. 1952.2.14.1) : *a*, mandible ; *b*, maxilla I ; *c*, segment 7 of posterior ramus of cirrus VI (all ×300) ; *d*, lower part of cirrus VI and caudal appendages (×90).

VERRUCOMORPHA

VERRUCA

Verruca striata Gruvel

Taken by the " Talisman " south of the Cape Verde Islands, Lat. 16° 51′ N., Long. 27° 30′ W. in 598–633 m. (Gruvel, 1902*a*) this is the only species of *Verruca* so far recorded from tropical West African waters, though many species are known from the warm temperate waters of Madeira and the Azores. As yet, no species has been found in West African coastal waters.

BALANOMORPHA

CHTHAMALUS

Chthamalus stellatus (Poli)

Four varietal forms of *C. stellatus* are recorded in the literature from West Africa, vars. *stellatus*, *depressus*, *fragilis* and *bisinuatus*, in addition to records where no varieties are specified. The records of *fragilis* and *bisinuatus* are considered below, the former as *C. fragilis*. Records of " *depressus* " refer to *C. aestuarii* Stubbings. Of the remaining records of " *C. stellatus* " and " *C. stellatus* var. *stellatus* " it is highly improbable that all refer to the var. *stellatus*.

C. stellatus var. *stellatus* (Poli)

Locality : Ghana, Winneba : shore Section, $\frac{1}{4}$ m.^{2}, no. 1A, 4.3.50 (1 spec.).

The southward extent of var. *stellatus* is difficult to determine from records owing to the confusion of forms in earlier reports. Records in the literature up to 1943 were cited in Stubbings (1961*a*). The more northerly records, namely Morocco (Broch, 1927), Rio de Oro (Nilsson-Cantell, 1939*b*), Mauretania (Broch, 1924*b*) and Madeira and Cape Verde Is. (Darwin, 1854) are acceptable. The Cape Verde record is confirmed by " Calypso " material (Stubbings, 1964*a*). Sourie (1954) records only *C. stellatus* in his study of the ecology of rocky shores from Mauretania to Guinea, thus including Senegal. Yet there were no *C. stellatus* in the cirripede collections from I.F.A.N., Dakar, studied by the writer, only two samples of *C. dentatus*. Assuming Sourie's identifications to be correct, some at least of which were made by Professor Hj. Broch of Oslo, this implies an abrupt change of predominant species in the region of Cape Verde. The northern species *C. stellatus* is predominant in Mauretania and south of the Cape the tropical and southern hemisphere species *C. dentatus*. Records from further south are suspect because of the possibility of confusion with *C. aestuarii* and *C. dentatus*. Thus Gruvel (1912) records *C. stellatus* from Libreville (Gabon) and Kitombe, Banana, at the mouth of the Congo. Weltner (1897) gives Victoria, Cameroons and Kolosvary (1943*a*) Fernando Po, as localities. There are no *C. stellatus* in the extensive collections from the Congo estuary, including Kitombe, in the collections of the Musée Royal de l'Afrique Centrale, Tervuren

(Stubbings, 1964*b*). Whilst " Calypso " did not visit Fernando Po, collections were made at the other islands in the Gulf of Guinea and no *C. stellatus* were collected (Stubbings, 1961*b*). In both areas *C. dentatus* was collected, and *C. aestuarii* is common in the Congo estuary. Weltner's record from Victoria is presumably correct as specimens were taken there by " Atlantide " (Stubbings, 1961*a*).

It would seem, therefore, that in West Africa *C. stellatus stellatus* is only common on the north-west coast (Morocco, Mauretania) and in Madeira and the Cape Verde Islands. It may occur sporadically in small numbers further south, certainly as far as the Cameroons, but in general it is replaced south of Cape Verde by *C. dentatus* in more exposed conditions and by *C. aestuarii* in the more sheltered conditions of estuaries.

C. stellatus var. ***bisinuatus*** Pilsbry

C. stellatus var. *bisinuatus:* Stubbings, 1961*a*, 18–19, text-fig. 3.

Specimens from Lagos, Nigeria in the University Zoological Museum, Copenhagen (Stubbings, 1961*a*) belong to this variety. There are no other West African records of this otherwise Brazilian variety.

Chthamalus dentatus Krauss

Localities: Gambia: No. 3 Gambia Lightship, 22.9.48, pres. M. W. H. Bishop, B.M. 1950.7.19.1 (several spec.).

Sierra Leone: Kissy, Sierra Leone River, on rocks above littoral fringe, coll. A. R. Longhurst, B.M. 1956.1.7.4 (32 spec.).

Ghana: (1) Ada, on launch " Akuse " (21 spec.); (2–9) Accra, (2) Christiansborg shore, 15.1.49 (several young uneroded spec.); (3) on *Thais haemastoma* L., 14.2.49 (several hundred spec.); (4) from splash zone, 14.2.49 (110 + 22 juv. + 5 dead spec.); (5) on *T. haemastoma, T. nodosa* L. and *Patella safiana* Lam., 17.3.49 (c. 100 + 50 juv. + 29 dead spec.); (6) on a limpet, 5.11.49 (123 + 20 juv. + 45 dead spec.); (7) on a large *B. t. tintinnabulum*, 19.11.49 (few spec.); (8) on a rubber tyre fender, 14.3.51 (several hundred spec.); (9) HWM on sandstone rock, 19.3.58, coll. H.G.S. (91 + 45 juv. spec.); (10–12) Winneba: (10) on rock and shells including *T. haemastoma, P. safiana* and *Mytilus perna* L., 15.11.49 (453 + 264 juv. + 32 dead spec.); (11) on similar substrate, 22.11.49 (several hundred spec.); (12) shore section made on 3/4.3.50 (over 1500 spec.); (13–16) Apam; (13) " high on shore ", 16.2.49 (many spec.); (14) on *Gadinia afra* Gmelin (44 + 25 juv. spec.); (15) embedded in a sponge (1 spec.); (16) on Gastropods including *T. haemastoma, T. nodosa* and *Nerita senegalensis* Gmelin (several hundred spec., about half juv.); (17) Sekondi, High Land Plateau, on sandstone rock, 21.2.49 (numerous spec.); (18) Prince's Town shore, 15.4.49 (1 spec.); (19) Axim, Hospital reef, H.W.M., 13.4.49 (several hundred spec.); (20) Axim, on reef, *B. t. tintinnabulum* and a limpet *Fissurella nubecula* L., 17.1.51 (184 spec.); (21) Ankobra ferry, on log, 19.2.49 (many spec.); (22) Half Assini, on wreck, —2.49 (217 + 2 juv. + 7 dead spec.); (23) Prampram, on rock fragment, —.11.37, pres. Miss V. J. Foote, B.M. 1952.5.7.2 (numerous spec.).

Nigeria: (1) Bonny River, fairway buoy in river mouth, in splash zone and down to 1 ft. below float line, with *B. pallidus* (45 spec.); (2) Bonny, on New Pier on concrete at HW and above with *C. aestuarii*, 28.11.57 (4 spec.) (H.G.S. 331).

I have seen further material from Labadi Beach, Accra, and Tema, Ghana, the west mole, Lagos and from Victoria, Cameroons, all collected by Dr. Eyvor Sandison.

This extensive material includes young and old, uneroded and eroded specimens, single individuals and densely packed colonies, the last sometimes showing some shell elongation. Where erosion is heavy shells become low and featureless and when densely packed sutures and even boundaries between specimens become indistinguishable. Young uneroded specimens are fawn or pale-brown with a thin epidermis.

The compartments are practically smooth, with only feeble longitudinal furrows on some of them. Growth lines are visible intermittently. The sutures are rather irregularly sinuous externally and not dentate.

With erosion the worn areas become marbled fawn or brown and white with the brown epidermis restricted to the newer basal parts of the compartments. In more heavily eroded specimens the shells may be wholly white.

The Nigerian specimens from a buoy at Bonny are large isolated broadly conical individuals, the largest 12 × 9·5 mm. diameter × 5 mm. high. In most the lower part of the paries is "narrowly and regularly folded" as described by Darwin (1854: 463) for shipborne specimens.

The development of the characteristic dentate sutures is variable. When well-

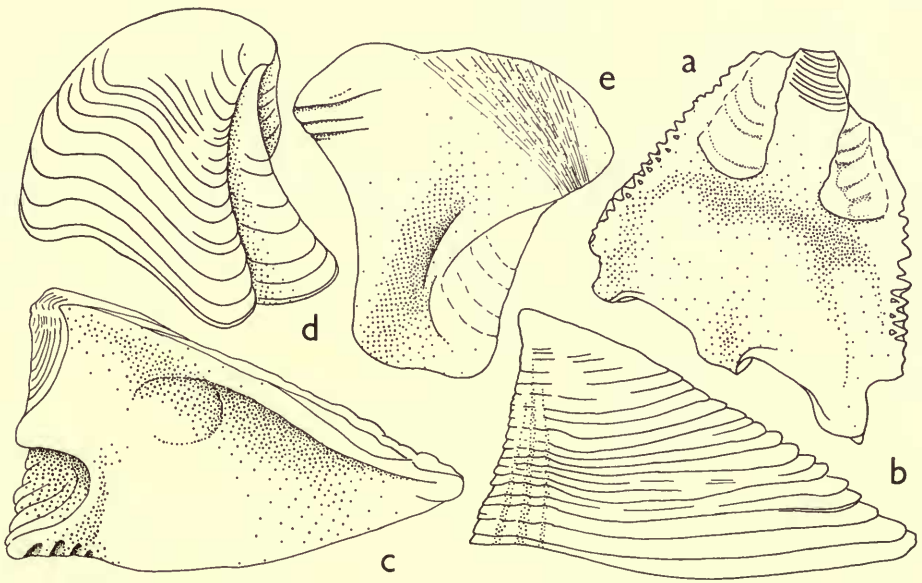

FIG. 8. *Chthamalus dentatus* Krauss: specimen from rubber tyre fender at Accra. *a*, internal view of rostro-lateral compartment with well-developed dentate sutures (×14); *b*, *c*, external and internal views of the scuta and *d*, *e*, of the terga of the same individual (all ×23).

formed and uneroded the zigzag sutures are clearly visible externally. The sutural surfaces or " teeth " are short ridges with sharp, angular crests, the sutures then appearing sharply dentate, or with smoothly rounded crests in which case the sutures become sinuous. The broader and lower these ridges the more the sutural line departs from a zigzag and approaches a straight line. Both angular and rounded sutural teeth are seen in the left rostrolateral compartment in Text-fig. 8*a*. In eroded shells it is often impossible to discern the dentate margin to the compartments. They can then be seen only from the inside of the shell or after dissociation of the compartments. The dentations may be obliterated by distortion during the growth of close-packed low-growing specimens. In elongated specimens the teeth may be very small or obscure on the lower part of the sutures which become more or less sinuous in outline.

Internally the dentations are often in a narrow groove which renders them less visible. In close-packed specimens the groove may be almost closed in the lower part and the sutures show only 1 or 2 dentations in the older part. These were presumably produced before the barnacles became contiguous. The clearest dentations are shown on specimens grown singly in sheltered places free from erosion, such as on piers or buoys.

Two forms of the shell and an internal view of the tergum were shown by Darwin (1854, pl. 18, figs. 3*a–c*). No figure of the scutum has been published. Internal and external views of both opercular valves are given here. The scutum (Text-fig. 8*b*, *c*) agrees well with Darwin's description in the very prominent articular ridge, which is most protuberant about the middle of the articular border and in the deep adductor pit and the row of small pits for the depresser muscles referred to by Darwin as " distinct, though minute, pits . . ." (1854 : 464). In some young specimens the broadest part of the articular ridge may be nearer the apex when the valve comes to resemble that figured by Pilsbry (1916, fig. 83) as *C. fragilis* Darwin. Specimens with this type of scutum but with well developed dentate sutures are in the collection so these are presumably *C. dentatus* though somewhat divergent from the norm. Externally uneroded scuta bear fairly prominent regular growth lines.

The tergum (Text-fig. 8*d*, *e*) agrees with Darwin's figure in the strong articular ridge and strongly curved carinal margin. The depressor muscle crests are on a projecting portion—" Auf einer vorspringenden Partie "—as remarked by Nilsson-Cantell (1921 : 284).

Mouth parts have been figured previously by Nilsson-Cantell (1921). There is a long series of small teeth and a row of hairs on the labrum (Text-fig. 9*a*). In some Nigerian specimens the labral teeth are less developed and less numerous. The palp (Text-fig. 9*b*) is broadly oval with the inner margin straight or slightly concave. The mandible (Text-fig. 9*c*) is close to that shown by Nilsson-Cantell (1921, fig. 52*c*, *d*). There have been divergent reports on the condition of the lower angle. Darwin (464) described it as " coarsely pectinated " but Nilsson-Cantell found most specimens to have only fine bristles here, a view concurred in by Barnard (1924). However, Nilsson-Cantell (1921) found an individual in which spines occurred among the hairs on the lower angle (his fig. 52*d*). The specimen here figured has fine spines on the lower angle.

Maxilla I (Text-fig. 9*d*) has a broad notch with small spines. Below it, the median spines are but little larger than the lower ones into which they grade smoothly. Maxilla II (Text-fig. 9*e*) is broad with a deeply concave anterior margin, the median concavity being devoid of bristles as noted by Nilsson-Cantell.

The number of segments in the cirri of two specimens, presumably from Madagascar, were given by Nilsson-Cantell (1921). These compare favourably with counts

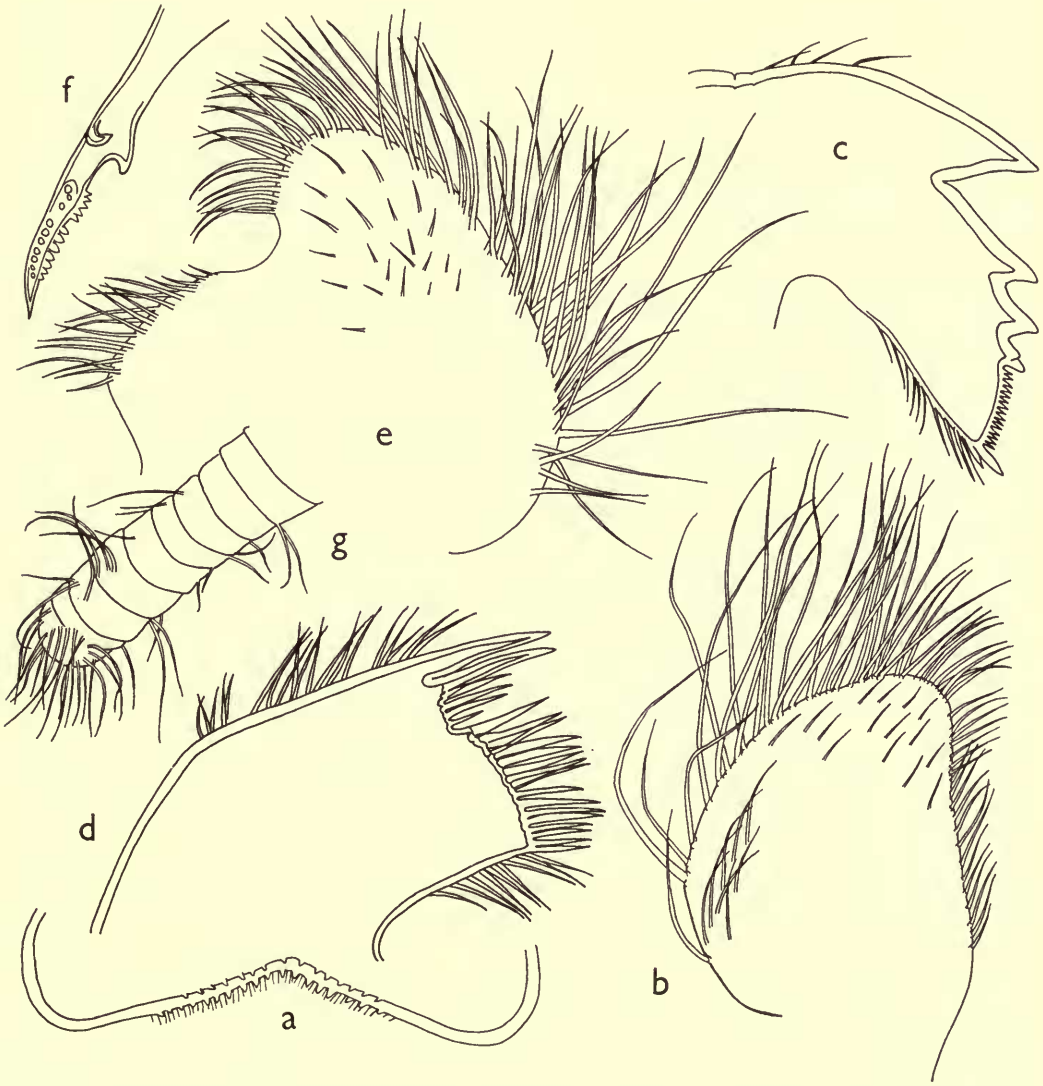

FIG. 9. *Chthamalus dentatus* Krauss : *a*, labrum ; *b*, palp ; *c*, mandible ; *d*, maxilla I ; *e*, maxilla II (all ×170) of a specimen from rubber tyre fender, Accra : *f*, compound spine from tip of cirrus II (×350) of a specimen from a buoy at Bonny, Nigeria ; *g*, tip of penis (×80).

made on specimens from Christiansborg, Accra and from Nigeria collected by the author. The number of segments in the right and left cirri of two specimens from each locality are given in Table 4.

TABLE 4

Specimen		I	II	III	IV	V	VI	Scutum mm.
Accra	L	7·6	6·5	15·15	16·16	18·18	18·19	1·85
	R	7·6	6·5	14·15	15·17	18·17	19·18	
Accra	L	7·8	7·5	14·14	17·16	16·16	18·18	2·11
	R	8·7	7·6	13·12	15·17	18·18	19·18	
Nigeria	L	8·7	7·7	20·19	23·23	24·24	24·24	3·51
	R	9·7	7·6	20·21	23·24	24·24	25·24	
Nigeria	L	7·6	6·5	18·19	22·23	24·25	27·24	3·44
	R	7·6	6·5	17·18	22·23	25·24	25·25	

TABLE 4. Number of segments in left and right cirri of four *C. dentatus*, with scutal lengths as an index of barnacle size.

The number of segments in the longer cirri in the Nigerian specimens but not in those from Accra is thus rather higher than previously recorded. Because of the distortion of some of the shells due to crowding the relative size of the above specimens is indicated by reference to the length of the base of the scutum. The Nigerian specimens were considerably larger than those from Accra, probably attributable to a more favourable environment on the navigation buoys. This size variation could account for the observed difference in segment counts. Pectinate spines (Text-fig. 9*f*) are present on the terminal segments of cirrus II.

The penis is closely annulated, the annuli broadening towards the distal end until about half as long as broad (Text-fig. 9*g*). The distal segments are sparsely clothed with long hair-like setae. A ring of similar setae surrounds the tip.

C. dentatus is found on the whole west coast of Africa, south of Cape Verde. There seems little doubt of its northern limit. There are few specimens in the IFAN collections at Dakar, suggesting that it is not common there. Furthermore, Sourie (1954) who investigated the coastline of Mauretania and Senegal rather thoroughly does not record it at all. Hoek (1883) records *C. dentatus* from the Cape Verde Is., but from his account the identification is uncertain. The species was not found in the archipelago by the " Calypso " expedition in 1959.

In the Gulf of Guinea the species is known from the islands of Principe and São Tomé (Stubbings, 1961*b*). South of the River Congo there are few records, largely due to the lack of collecting on this coastline. At the Cape it is common from False Bay to Durban (Sandison, 1954). According to Miss Sandison it is uncommon in the cold water current on the west side of the Cape Peninsula and this, presumably, will apply to the Atlantic coast of South Africa and South-West Africa where influenced by the cold Benguela current. As at Capetown, however, it is not entirely absent from this section of the coast, as witness the record for Walvis Bay (Stubbings, 1963).

Four isolated records, two in Madagascar (Nilsson-Cantell, 1921), one each in Mauritius (Weltner, 1897) and Aden (cited by Nilsson-Cantell, 1921, without author-

ity) extend the distribution of *C. dentatus* into the Indian Ocean and a fifth (Weltner, 1897) to Singapore.

Chthamalus aestuarii Stubbings

Chthamalus aestuarii Stubbings, 1963, 7, text-figs. 2, 3.
Chthamalus stellatus depressus: Nilsson-Cantell, 1938*b*, 177, text-fig. 2.
Chthamalus cirratus: Kolosvary, 1941*b*, 70.
Chthamalus cirratus: Kolosvary, 1943*a*, 75.
Chthamalus stellatus f. *depressus:* Gauld, 1957, 10.
Chthamalus rhizophorae: Longhurst, 1958, 32, 59, 85.
Chthamalus withersi: Longhurst, 1958, 59, 85.

Localities: Sierra Leone: (1) Bunce I. Sierra Leone River, on mangrove, 1955, coll. A. R. Longhurst, B.M. 1956.1.7.3 (as *C. rhizophorae* Oliveira); (2) Sierra Leone River on mangrove, July 1955, coll. A. R. Longhurst B.M. 1957.6.3.3 (as *C. withersi* Pilsbry); (3) Reef at Wellington, Sierra Leone River on mangrove, 19.7.55, coll. A. R. Longhurst, B.M. 1956.7.1.5 (as *C. withersi*).

Ghana: (1) R. Densu on mangrove, 3.4.49.; (2) Prince's Town, on mollusc shell fragment, 15.4.49 (1 spec.); (3) Ada, R. Volta, at H.W.M. on pier, 15.3.49 (numerous spec.).

Nigeria: (1) Port Harcourt on concrete "dolphin", 19.12.57 (37 spec.) (H.G.S. 350); (2) Bonny R. estuary, on concrete pier at Bonny, 28.11.57 (6 spec.) (H.G.S. 323); (3) Opobo, Imo River, E. Nigeria, on pier and on *B. pallidus*, 11.1.58 (12 spec.) (H.G.S. 373).

In addition I have seen specimens collected by Miss Sandison from Badagri Creek and Kuramo Creek, near Lagos, from Porto Novo lagoon, Dahomey and the R. Baka, near Elmina, Ghana, all on bark, probably of mangroves.

This species was described fully from material from the Congo estuary by Stubbings (1963). The present material establishes its presence over the whole tropical West African coastline where conditions are favourable.

In examining further material from a greater geographical area some variations in form have been observed and are illustrated here. In my original illustration a slightly eroded specimen in which growth lines were not apparent was figured. This specimen had radiating dark brown or black lines on the parieties. The young and uneroded specimen now figured (Text-fig. 10*a*) from the Sierra Leone river lacks these black lines and the incremental lines are quite distinct. The scutum (Text-fig. 10*b,c*) has a much more oblique basi-tergal angle and the basal margin is less strongly bowed. In other respects the scutum resembles my earlier figures, in particular in the protuberant apical region of the articular ridge.

Internally the tergum shows some variation. The articular furrow is always well developed and rather broad. Text-figs. 10*d, e* are external and internal views of the terga of the specimen from which the scuta came. The articular furrow here was of average size. The depressor muscle crests on the other hand were reduced to one, instead of the normal three or four as in Text-fig. 10*f*. This latter specimen had a very broad open articular furrow with a rather uneven surface. A specimen from Port Harcourt (Text-fig. 10*g*), showed a similar rough broad articular furrow. This

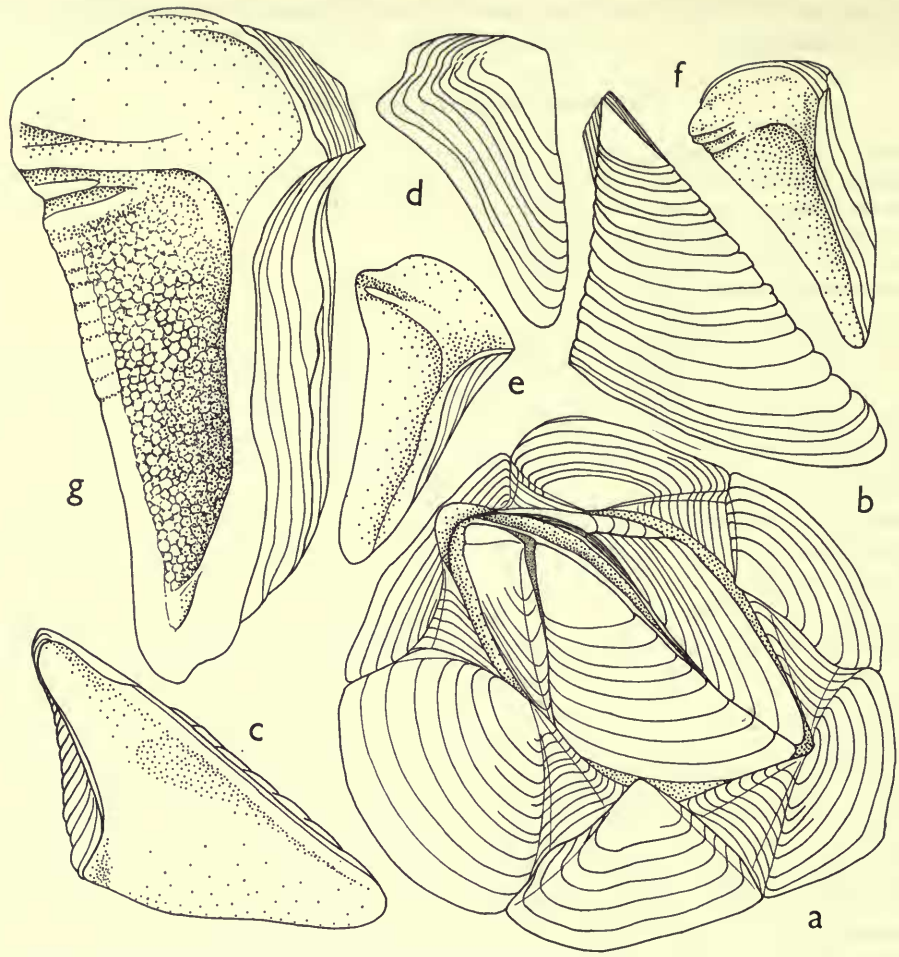

FIG. 10. *Chthamalus aestuarii* Stubbings: *a*, uneroded specimen from Sierra Leone River showing distinct growth lines and no pigment bands (×17); *b*, *c*, external and internal views of the scuta, and *d*, *e*, of the terga of another Sierra Leone specimen; *f*, internal view of tergum of a third specimen (*b–f*, all ×65) (B.M. 1957.6.3.3); *g*, tergum of a specimen from Port Harcourt, Nigeria, with broad articular furrow and roughened internal surface (×28).

rather massive valve was noteworthy for the very rough interior and for the apparent differentiation of a tiny spur from the basi-scutal angle.

The mouth appendages with the exception of Maxilla II were illustrated by Stubbings (1963). Minor variations are shown by the appendages illustrated in Text-fig. 11. In a Port Harcourt specimen (Text-fig. 11*a*) the row of teeth on the labrum is rather shorter. In a specimen from Sierra Leone (B.M. 1957.6.3.3) (Text-fig. 11*b–d*) the mandible has 3 simple teeth without subsidiary cusps. In the maxilla the central group of spines is demarcated by a very weak notch below as well

as by one above. In this it approaches *C. rhizophorae* Oliveira but the frontal margin of the maxilla is still straight and not stepped as in *C. rhizophorae*. Maxilla II has a concave anterior margin and a very strongly convex posterior margin. The setae are all simple. The cirri are as previously described. The number of segments in the right and left cirri of a Sierra Leone specimen are given in Table 5.

TABLE 5

	I	II	III	IV	V	VI
right	8·6	8·8	17·20	25·?*	24·?*	20·23
left	8·6	9·9	24·24	19·22	21*+·24	21*+·21*+

* cirri IV and V of the right side lacked one ramus : cirri V and VI of the left side lacked the last few segments.

TABLE 5. Number of segments in right and left cirri of a specimen of *C. aestuarii*.

These figures are in good agreement with the segmentation of the cirri of a Congo specimen (Stubbings, 1963 : 9).

The above-sited synonymy was reviewed at some length by Stubbings (1963) and that discussion need not be repeated here. With the exception of *C. withersi* and *C. rhizophorae* the species confounded with *C. aestuarii* have in general been described and figured adequately in the past. The appearance of full-grown *C. withersi* is now revealed through the work of Pope (1965) but no further figures of *C. rhizophorae* have appeared since the original descriptions by Oliveira (1940, 1941).

As Miss Pope has cast doubt on the status of *C. rhizophorae* as a separate species—and by implication of *C. aestuarii* (1965 : 40) a further series of figures of scuta and terga of *C. rhizophorae* from the same general area as the type are given here (Text-fig. 12).

Comparison of these valves with those of *C. aestuarii* (Text-fig. 10 and Stubbings, 1963, fig. 2) shows at once the differences and resemblances in the opercular valves of the two species. The shape of the articular ridge of the scutum alone (Text-figs. 10*b*, *c* and 12*a*, *c*) separates the two species immediately. The presence of pits in the inner surface of the scutum and to a lesser extent of the tergum also seems characteristic of *C. rhizophorae*. These pits are visible in Oliveira's (1940) photographs, but were not indicated in his line drawings of the valves (1941). Very heavy and thick valves may occur in *C. rhizophorae* (Text-fig. 12*c*, *d*) and in terga of this type the articular surface is even broader than in *C. aestuarii*.

The three 'species' have been compared using material from Queensland (*C. withersi*), Brazil (*C. rhizophorae*) and West Africa. The chief points distinguishing *C. aestuarii* from *C. withersi* are described below.

The psi (ψ) shaped articulation of the opercular valves is shown by all except young uneroded *aestuarii* but not by *withersi*. The articular ridge and furrow of the scutum form only "a shallow wavy fold and trough" (Pope, 1965 : 42) in *withersi*. There are scarcely any interlocking surfaces. It is, in fact, one of the most poorly developed examples of this structure in *Chthamalus*. In *aestuarii* the ridge is much stronger and interlocks with the tergum. The area of the ridge towards the valve apex projects beyond the tergal margin of the scutum. In the tergum the chief

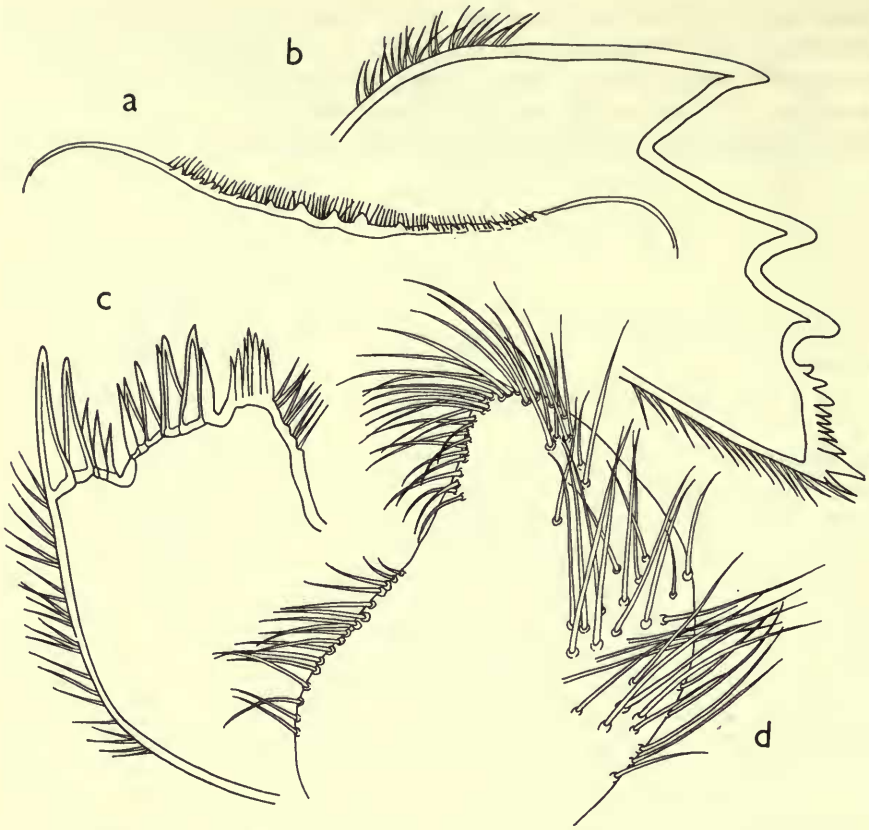

FIG. 11. *Chthamalus aestuarii* Stubbings : *a*, labrum of a specimen from Port Harcourt ; *b*, mandible, *c*, maxilla I, *d*, maxilla II of the same Sierra Leone specimen as the opercular valves in Fig. 10*b–e* (all ×170).

difference lies in the articular margin. As in *withersi* it is inturned at right angles to the plane of the main valve surface. But whereas in *withersi* there is only a very narrow articular surface in *aestuarii* it is much broader. To accommodate this greater articular surface the scutal margin is turned further back on itself so that much of the articular surface lies in a plane parallel to that of the main part of the valve.

In young *rhizophorae* the articular ridge of the scutum is only modestly developed but its middle portion projects forward over the articular groove. In old and massive valves which have only suffered slight erosion, the interlocking surfaces of scutum and tergum are very broad and flat, being again roughly parallel to the external surface of the valves.

On these characters it is quite possible to distinguish the three species.

Differences in the mouth appendages are rather variable. The redescription of the labrum by Miss Pope removes the earlier distinction of a short line of teeth on its edge in *withersi*. The *withersi* mandible evidently varies in the number of major

teeth from three to occasionally four. The curiously " hard " outline of the teeth shown by Pilsbry and present in my material—seemingly due to the straight margins of the teeth in profile—is not seen in *aestuarii* or *rhizophorae*. The lower angle terminates in a few short spines in my *withersi* but in *aestuarii* and *rhizophorae* the number of spines is greater and they form a " comb " below the third tooth. There is some variability in these spines. Those shown in Text-fig. 11*b* are appreciably shorter than those in my original description (Stubbings, 1963, fig. 3*c*).

In *withersi*, and *rhizophorae* the edge of maxilla I has two notches and is " stepped ", the lower sections protruding well in front of that or those above. In *aestuarii* the edge is almost straight with a small notch below the upper group of spines. In the specimen originally figured there was no lower notch. In that now shown there is a slight indication of this lower notch. It is more apparent than real, its presence being emphasized by the disposition of the spines and the thickening of the cuticle here.

In view of the above differences it is considered that *C. aestuarii* and *C. withersi* are distinct species albeit occupying very similar habitats. Though less material has been available, it would seem that *C. rhizophorae* also is a distinct species.

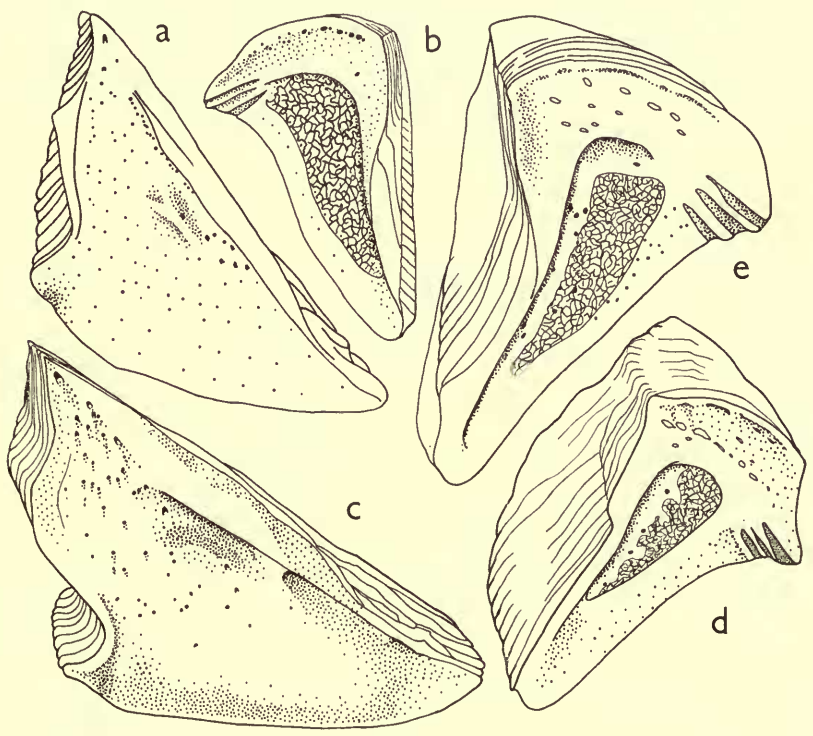

FIG. 12. *Chthamalus rhizophorae* Oliveira : internal views of *a*, *b*, right scutum and tergum of one specimen, *c*, *d*, right scutum and left tergum of a second, and *e*, left tergum of a third specimen (all ×12).

Chthamalus fragilis Darwin

LOCALITY : Bota, Cameroon : on *Ostrea* sp. from a lighter, 21.2.58 (22 spec.) (H.G.S.426).

Chthamalus fragilis was recorded by Broch (1927*a*) from Tangier and is grouped as an Atlantic–Mediterranean species by Kolosvary (1941*b*), presumably on this record. There are no other records for north or west African coasts. The species is common apparently on the warmer Atlantic coastline of North America and in the West Indies (Darwin, 1854 ; Pilsbry, 1916 ; Nilsson-Cantell, 1933, 1939*c* ; Kolosvary, 1943*a* ; Weiss, 1948). Broch (1927*a*) did not figure the Tangier specimens. Figures have been given of American (Pilsbry, 1916, pl. 70 and text-fig. 83) and West Indian specimens (Nilsson-Cantell, 1928, text-fig. 14 ; 1933, text-fig. 1). The walls of the present specimens are smooth and white with a thin pale yellow persistent epidermis. Growth lines are present and easily traced but are very low. Radii are present but small, and the interparietal areas are very narrow. The tergum (Text-fig. 13*a*) agrees closely with that figured by Pilsbry (1916, text-fig. 83A). The spur is distinct from the basi-scutal angle but is rounded, not pointed as in some of Pilsbry's examples and in the two shown by Nilsson-Cantell (1933, text-fig. 1). The scuta are shown by Pilsbry only. That figured here (Text-fig. 13*b*), is in good agreement with Pilsbry's text-fig. 83C and his pl. 70, fig. 3. The depressor muscle pit is not appreciably deeper than the shallow depression behind the articular ridge. The adductor pit lies in a very pronounced furrow parallel to the occludent margin of the valve.

The mouth parts are, as stated by Pilsbry, very like those of *C. stellatus stellatus* and agree with this author's figures for the latter species.

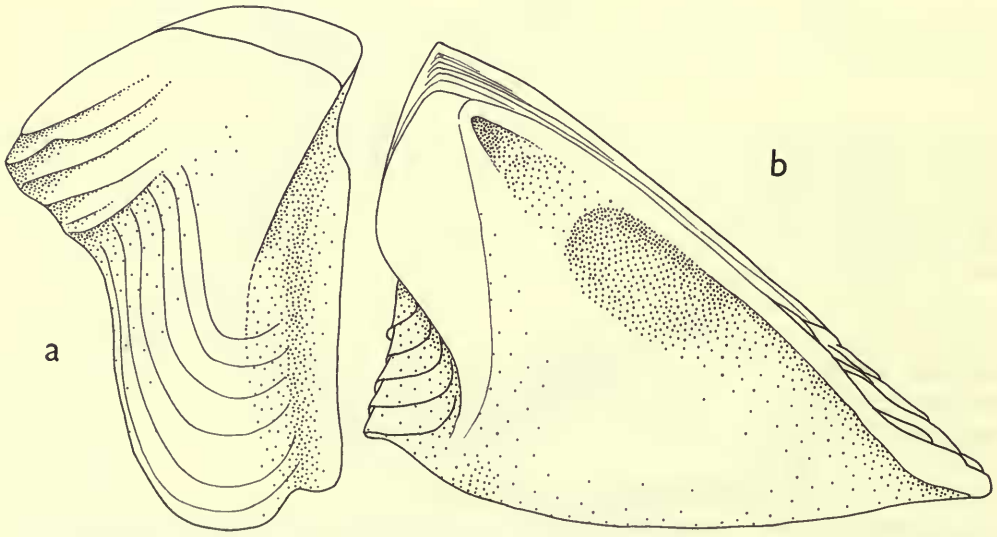

FIG. 13. *Chthamalus fragilis* Darwin : internal views of *a*, tergum and *b*, scutum of a specimen from Bota, Cameroon (×80).

Pachylasma giganteum (Philippi)

This Mediterranean species has been recorded twice only from other waters. Gruvel (1907*b*, 1910) records it from Simonstown, South Africa in the collections of the " Gauss " and Kolosvary (1943*a*) from Sette Cama, Gabon. The latter is the only record for West Africa. Darwin (1854) remarks that *P. giganteum* is often associated with *B. tulipiformis*, but although the latter species has been collected frequently no *Pachylasma* have been recorded.

Other species of *Pachylasma* have been described from the Indian Ocean, South-east Asia and Australia. Specimens of all species of *Pachylasma* are rare and the degree of variation within any one species is uncertain. As Nilsson-Cantell (1932*b*) has pointed out, it is probable that some at least of these described species are no more than sub-species of *P. giganteum*. Until more material is available especially of *P. giganteum* from the Mediterranean and Atlantic the validity of these species, and therefore, the geographical distribution of each, must remain problematical.

BALANUS

Balanus tintinnabulum (Linn.)

Only one variety or subspecies of *B. tintinnabulum* is common on the west coast of Africa, namely *B. tintinnabulum tintinnabulum* (L.). The occurrence of two other varieties has been fairly definitely established but the presence there of several others mentioned in the literature is highly doubtful.

Balanus tintinnabulum tintinnabulum (L.)

Balanus tintinnabulum tintinnabulum Pilsbry, 1916, 55–57, pl. 10, figs. 1–1*e*.

Localities: Gambia: (1) off Gunjur, on hull of shark fishing boat, 3.3.51, coll. M. H. Routh, B.M. 1952.10.2.3 (14 half grown and 11 very small spec. <11 wks. old); (2) from sea water intake of " African Queen ", encrusted with *B. pallidus* and a few *B. amphitrite amphitrite* and *B. trigonus*, 2.10.51 coll. M. H. Routh, B.M. 1952.10.2.5 (3 part-grown spec.).

Sierra Leone: (1) hull of S/T " Cape St. Mary ", 2–3 m., –.12.54 coll. A. R. Longhurst, B.M. 1956.1.7.10 (3 fairly large + 1 small spec. and remains of another); (2) Sierra Leone River, probably from ship's hull, –.7.55 coll. A. R. Longhurst, B.M. 1957.6.3.4. (5 small spec.).

Ghana: (1) Accra Sta. 86 (several clusters of small dead spec.); (2) Prince's Town, on a fragment of a large mollusc shell bored by *Kochlorine hamata* Noll (Cirripedia Acrothoracica) and by the Lamellibranch *Lithophaga aristata* (Solander) Dillwyn (2 dead spec.); (3) Half Assini, from a wreck, with epizoic *C. dentatus* (1 half-grown spec.); (4) Hospital Reef, Axim, including 3 small dead specimens overgrown by sponge, several clusters of mixed sizes, 2 damaged specimens and a shell with encrusting algae and *C. dentatus* (numerous spec.); (5) Apam shore, including two small, thin and fragile specimens on a siliceous sponge and three large ones overgrown by Zoanthid colonies (8 spec.); (6–7) Winneba: (6) shore, encrusted with calcareous

algae and with attached *C. dentatus* and *Mytilus perna* L. (3 spec.); (7) rock face, with attached *C. dentatus*, encrusting algae and Polyzoa (2 large spec.); (8–19) Accra; (8) on moorings (1 small spec.); (9) boat buoy, attached to *C. dentatus* and associated with *B. amphitrite* (1 small spec.); (10) on copper sheathing of boat and attached to *B. amphitrite amphitrite* (3 juv. spec.); (11) Christiansborg shore, embedded in a sponge but attached to the hard substrate (1 spec.); (12) the same, 15.1.49 with a few small epizoic *C. dentatus* (2 spec.); (13) the same, part attached to the keyhole limpet *Fissurella coarctata* King and part with epizoic *C. dentatus*, 19.4.49 (1 + 2 small spec.); (14–19) from " Bottom net "; (14) 14 m., 27.4.51 (2 + 2 juv. dead spec.); (15) 13 m., 5.5.51, on sunken wood (1 damaged spec.); (16) 26.10.51 (numerous small clusters); (17) 12 m., 30.10.51, with bright pink stripes (3 small spec.); (18) 13.11.51, two small clusters (9 + 5 dead spec.); (19) 10 m., 9.1.52, a dead cluster (5 + 2 juv. spec.).

Nigeria: (1) Lighthouse Beach, Lagos, on cork with *B. venustus venustus* and *Chelonibia patula* (1 juv. spec.); (2) Bonny River, from No. 2 buoy at entrance to the river (1 juv. spec.); (3) the same, from buoys Nos. 3 and 4, near river mouth and from buoys between Dawes I. and Port Harcourt, many elongated through crowding and many with epizoic *B. pallidus* (numerous spec.).

The material from Ghana listed above is predominantly small and white or pale pink with lines of a deeper and often much brighter colour. The Nigerian material is older and the shells are pink with white or bluish radii. Apart from distortion due to crowding or substrate irregularities there is very little variation among the specimens which are all readily referable to the type variety.

B. tintinnabulum tintinnabulum is distributed along the whole west coast of Africa from the Mediterranean to the Cape. Off shore it occurs in the Cape Verde Archipelago (Stubbings, 1964*a* ; Hoek, 1883) and on the islands of São Tomé and Principe in the Gulf of Guinea but was not recorded from Annobon, the outermost of this island chain (Stubbings, 1961*b*). Darwin (1854) mentions Madeira. So far there appear to be no records of *B. t. tintinnabulum* from the Islands of Ascension and St. Helena.

The local distribution of *B. tintinnabulum* in West Africa depends upon the provision of a suitable substrate. Thus Sourie (1954) records it as abundant at Dakar and Conakry but absent from the friable rocks in the Cap Blanc region. In Sierra Leone, Longhurst (1958) records it from ships : presumably it will occur there also on buoys. In Ghana and in the Cameroons it is found wherever rocky shores occur (Gauld, 1957). In Nigeria it occurs on the stone breakwater of Lagos harbour and in the Niger Delta (Bonny river) on navigation buoys. The deciding factor is clearly a hard substrate.

Balanus tintinnabulum zebra Darwin

Balanus tintinnabulum var. (4) *zebra* Darwin, 1854, 195, pl. 1, fig. *g*.
Balanus tintinnabulum var. 4. *zebra:* Weltner, 1897, 260.
Balanus tintinnabulum var. *zebra:* Stubbings, 1961*a*, 21.
Balanus tintinnabulum zebra: Stubbings, 1964*a*, 108.

Locality : Nigeria, Bonny river, No. 3 buoy, 14.12.57 (1 small specimen), (H.G.S. 339).

The variety *zebra* was recorded by Weltner from Walvis Bay, S.W. Africa. Gruvel (1910) records it as taken from the hull of " Gauss " on several occasions, no precise provenance being assignable. There is a suggestion that some at least settled whilst the ship was in harbour at St. Vincent, Cape Verde Is.

Specimens were taken from the hull of " Atlantide " in Lagos and in Le Havre (Stubbings, 1961*a*) and must have originated in West Africa. The same author (1963) reports specimens from Brava, Cape Verde Is. *B. t. zebra* would thus appear to occur on the west coast of Africa over a wide range of latitude in both North and South Atlantic. It is evidently much less common than the type variety.

Balanus tintinnabulum spinosus (Gmelin)

Balanus tintinnabulum var. (6) *spinosus:* Darwin, 1854, 196, pl. 1, fig. *i*.
Balanus tintinnabulum var. 6 *spinosus:* Weltner, 1897, 260.
Balanus tintinnabulum spinosus: Pilsbry, 1916, 58–59, text-fig. 10.
Balanus tintinnabulum spinosus: Nilsson-Cantell, 1932, 109.
Balanus tintinnabulum spinosus: Stubbings, 1961*b*, 184–7, text-figs. 2–4.

The known distribution of this form off West Africa was discussed by Stubbings (1961*b*). No further specimens have so far been recorded and none is known from the mainland West Coast of Africa. Nothing can be added, therefore, to the suggestion proffered in that paper that *B. t. spinosus* is an oceanic island form of *B. tintinnabulum*.

Balanus tintinnabulum crispatus (Schröter)

Balanus tintinnabulum var. (5) *crispatus:* Darwin, 1854, 195, pl. 1, fig. *h*.

Gruvel (1903) records this variety from Senegal, but there are no other old published records of this variety from West Africa and the present writer has seen none in the more recent materials examined. It must be regarded as only very doubtfully a West African barnacle.

Balanus tintinnabulum concinnus Darwin

Balanus tintinnabulum var. (8) *concinnus* Darwin, 1854, 196, pl. 1, fig. *e*, pl. 2, fig. 1*g*.

This variety is distributed on the west coast of South America (Darwin, 1854; Pilsbry, 1909; Kolosvary, 1943*a*), and is known from Siam (Broch, 1931) and New Zealand (Jennings, 1918; Moore, 1944). The only West African records are those of Gruvel (1903) for the Congo and Rio Muni. Pilsbry (1916) has already observed that if these records truly pertain to *B. t. concinnus* they must be based on specimens taken to those places by ship. It is unlikely that it occurs naturally in West Africa.

Balanus tintinnabulum azoricus Pilsbry

Balanus tintinnabulum azoricus Pilsbry, 1916, 62, pl. 12, figs. 2, 2*a*, 2*b*.

Pilsbry (1916) erected this subspecies to accommodate specimens from Terciera Is., Azores. It does not appear to have been identified in subsequent collections. There are resemblances to both *concinnus* and *tintinnabulum* and it may be that

Gruvel's *concinnus* from the Congo and Rio Muni is referable to this variety, in which case *B. t. azoricus* may yet be found in West African waters.

Balanus tintinnabulum forma ***maroccana*** Broch

Balanus tintinnabulum f. *maroccana* Broch, 1927, 21–22, pl. 1, figs. 4–6; pl. 2, figs. 7–8.

Broch (1927*a*) erected this forma for small specimens of *B. tintinnabulum* in which the tergal spur occupied one-half to two-thirds of the base of the valve and in which the spur fasciole was broad and shallow and never closed as in most *B. tintinnabulum*. The form was obtained well north of the tropic zone, some specimens coming from Lat. 34° 17′ N. They must be regarded as primarily warm temperate in habitat. There is a possibility, however, that specimens may be found in lower latitudes, being brought down the African coast by the Canary Current.

Balanus tulipiformis Darwin

Locality : Off Ghana, on Kotonu-Grand Bassam telegraph cable, 55 m., 5° 25′ 45″ N., 0° E., on old shells of *B. t. tintinnabulum* pres. E. and A. Telegraph Co., B.M. 1927.8.10.6 (1 spec.).

This species is not represented in the Nigerian and Ghanaian collections here recorded, though Gauld (1957) reports its abundance off Accra in depths of more than 50 m.

B. tulipiformis has long been known as a Western Mediterranean species (Ellis, 1758 ; Darwin, 1854 ; Nilsson-Cantell, 1921, 1932*a* ; Kolosvary, 1944*b* ; Utinomi, 1959*a*). According to Kolosvary (1944*b*) it is absent from the Adriatic and the Black Sea. In the Atlantic it is known from Madeira (Darwin, 1854 ; Gruvel, 1920), Bay of Biscay (Biarritz) (Kisch, 1958, 1959), Berlengas Is. off Cape Carveiro, Portugal (Gruvel, 1912), Canary Is. (Gruvel, 1920), Rio de Oro (Stubbings, 1961*b*), Cape Verde Is. (Stubbings, 1964*a*), Senegal (Stubbings, 1965), Ghana (Gauld, 1957 ; Buchanan, 1957, 1958), Gulf of Guinea (Principe Is.) (Stubbings, 1961*b*), Congo estuary (Stubbings, 1964*b*) and Angola (Stubbings, 1961*a*). This last in Lat. 8° 30′ S. is the most southerly record of the species. There is no record of *B. tulipiformis* from South-west Africa or the Cape of Good Hope, neither has it been recorded from the South Atlantic islands of Ascension and St. Helena.

There are no western Atlantic records of the species and apart from Gruvel's (1907*a*) record from Wasin Is., E. Africa there is none from the Indian Ocean. The geographical range of *B. tulipiformis* is confined to the eastern Atlantic from about 43° 30′ N. to 8° 30′ S. and the Western Mediterranean basin. It is a sublittoral species occurring in depths of from 25 to 250 m.

Balanus nigrescens Lamarck

This Australian–West Pacific species is recorded from San Pedro, Ivory Coast by Gruvel (1903). There are no other records of the species occurring naturally in the Western hemisphere. It is found occasionally as a fouling species on ships (Wood

and Allen, 1958) and Kruger (1927) records dead specimens removed from a ship's hull in Copenhagen. It is possible, therefore, that the Ivory Coast specimens were originally obtained from a hull, though Gruvel does not mention any substrate. Mme. Davadie (1963) has published photographs of the opercular valves of the Ivory Coast material from which it would appear that the identification is unquestionable. The real status of *B. nigrescens* in West Africa is therefore uncertain.

Balanus maxillaris Gronovius

The geographical distribution of *B. maxillaris* appears to be centred on the southern extremity of Africa from which it extends into sub-Antarctic waters (Nilsson-Cantell, 1939*a*). It has not been recorded from tropical West Africa, but there are records from Port Etienne, Morocco (Nilsson-Cantell, 1939*b*) and Luderitz Bay and Swakopmund in S.W. Africa (Kolosvary, 1943*a*, *b*). It is possible that these occurrences are due to shipborne introduction of the species. Both the northern and southern localities cited lie within areas influenced by equatorward cold currents and it is possible, therefore, that under these influences the species may extend further towards the equator in both hemispheres.

Balanus trigonus Darwin

Balanus trigonus Darwin, 1854, 223–4, pl. 3, figs. 7*a–f*.

Localities: Gambia: (1) off Gunjur from hull of shark-fishing boat, on *B. t. tintinnabulum*, 3.3.51, coll. M. H. Routh, B.M. 1952.10.2.3 (few juv. spec.); (2) from seawater intake of " African Queen ", on *B. t. tintinnabulum*, 2.10.51, coll. M. H. Routh, B.M. 1952.10.2.5 (2 juv. spec.).

Sierra Leone, (1) 12.1.52, coll. A. R. Longhurst, B.M. 1957.6.3.5 (19 dead spec.); (2) coll. on board S/T " Cape St. Mary " P. H. Creutzberg, pres. A. R. Longhurst, B.M. 1956.1.7.11 (9 dead and 1 live spec.).

Balanus trigonus is of world-wide distribution in tropical and subtropical waters. In the Atlantic it occurs from the Azores and Madeira to the Cape of Good Hope in shallow water. It is present in the Mediterranean. On the African Mediterranean Coast there are records from Oran (Kolosvary, 1943*a*). It was not reported by Broch (1927) from the Atlantic Coast of Morocco but Gruvel (1912) states that it occurs on all the Atlantic Coast of the Sahara (i.e. Mauretania). Sourie (1954), also reports its abundance at Cap Blanc, Mauretania and at Dakar, Senegal. It is very common on the Senegal Coast (Stubbings, 1965) and was present in almost all the " Calypso " collections made in the Cape Verde Archipelago (Stubbings, 1963).

From south and east of Senegal there are very few records. Longhurst (1958) obtained it twice only in his survey of the benthos off Sierra Leone. There are no records from Liberia, the Ivory Coast or Ghana and only one from Lagos, Nigeria (Stubbings, 1961*a*). From Liberia this lack of records may be due to lack of investigations but the absence of the species from Ghana must be real in view of the extensive collecting by Bassindale. It was not found among the islands of the Gulf of Guinea.

South of the Bight of Biafra records are again more frequent and *B. trigonus* is recorded down to Tiger Bay on the southern border of Angola (Gruvel, 1912). There is a single record from Great Fish Bay, South-west Africa (Weltner, 1922). In this paper Weltner reports the species from various localities in the Cape and Barnard (1924) states that it is found all round the South African coast from False Bay to Zululand.

It would appear, therefore, on present information that *B. trigonus* is common on the N.W. Atlantic coast of Africa, it being most abundant in the Senegal–Cape Verde area. From about 10° N. to 5° S. it is evidently uncommon. Collecting on the coasts of Angola, South-west Africa and the western coast of the Union has not been intensive, largely due to difficulties of access, but such records as we have would indicate that *B. trigonus* is present throughout this section of the coast. It is evidently common on the southern coast of the Union and well into the Indian Ocean.

Balanus spongicola Brown

B. spongicola is not contained in the present collections. It is widespread in the eastern Atlantic and Western Indian Ocean. In West Africa there are records from French Guinea (Stubbings, 1961*a*), Rio de Oro and Ghana (Stubbings, 1961*b*) and Angola (Stubbings, 1963). It is known from the western Mediterranean, Algiers (Darwin, 1854) and Catania (Kolosvary, 1943*a*). Northwards it extends to Portugal (Kolosvary, 1943*a*), Madeira (Darwin, 1854), the Azores (Gruvel, 1920) and the south-west coast of England (Darwin, 1854 ; Norman & Scott, 1906).

The identity of *B. dollfusi* Broch (1927*a*) with *B. spongicola* has been discussed by the author (Stubbings, 1963) elsewhere. All records of this species in the literature refer to localities whence *B. spongicola* has been collected or are within its known geographical range, namely the Atlantic coast of Morocco (Broch, 1927*a*) Rio de Oro (Nilsson-Cantell, 1939*b*) and off the Congo estuary (Nilsson-Cantell, 1938*b*).

Gruvel (1907*b*, 1910) records it from Simonstown, South Africa and Barnard (1924) from numerous places from False Bay to Zululand. In the Indian Ocean it is found in the Chagos Archipelago and Seychelles (Gruvel, 1907*a*). Kolosvary (1943*a*) cites specimens in Budapesth from the East Indies, but there are no other records from this region and confirmation by new material is desirable.

Darwin (1854) placed some specimens from the West Indies in an unnamed variety, but was uncertain as to their true status. Pilsbry (1916) elevated these to specific status as *B. calidus*. It is probable that the W. Indian and tropical American material recorded as *B. spongicola* by Weltner (1897), Nilsson-Cantell (1927) and Kolosvary (1943*a*) should be assigned to Pilsbry's species, though in neither of the two last cited works does the author mention *B. calidus*.

Balanus perforatus Brug.

This species is not represented in the Ghanaian or Nigerian materials here reported. Recent records of the species in West Africa are from the southern portion of its

range, south of the Bight of Biafra : Fausse Pointe Noire (Congo) (Stubbings, 1964*b*) and Lobito and Moita Seca, Angola (Stubbings, 1963).

B. perforatus exhibits the same divided distribution in West Africa as does *B. trigonus*. There are a number of records from Morocco and Mauretania (Broch, 1927*a* ; Gruvel, 1912) and the Canary Islands (Nilsson-Cantell, 1932*a*). Darwin names the Gambia as a locality and Bruguière (1789) cites Senegal in his original description, but there are no other localities recorded to the southward until Pointe Noire in Congo (formerly French Equatorial Africa) is reached. The species is unknown from south of Senegal to the southern border of the Gulf of Guinea. There are several records from the Congo and Angola but it has not been found on the south-west coast south of Lobito, Angola. Gruvel (1907*b*, 1910) records the species from rocks at Simonstown, South Africa.

The cited records include references to the vars. (or formae) *angustus* and *fistulosus*, both being growth forms, the former occurring where erosion is slight, the latter due to overcrowding. The collected and recorded material of *B. perforatus* from West Africa is unsatisfactory in that much of it consists of empty shells, dead when collected. There is, therefore, an element of doubt as to the true status of the species in some of the recorded localities. Dead shells may be the remains of an indigenous species, be derived from imported specimens that have bred but not been able to maintain themselves, or be merely the remains of imported shipborne specimens. It is probable that many of the present records represent shipborne introductions that have failed to maintain themselves for more than a short period. Until much more living material, preferably in clusters comprising individuals of various ages, is available, there must remain an element of doubt regarding the true status of *B. perforatus* in West Africa. In any case, it seems safe to presume its absence from about Lat. 10° N. to 5° S.

The geographical limits of *B. perforatus* beyond south-west Europe and the west coast of Africa are somewhat debatable. Its general distribution in the Mediterranean is undisputed and Zevina & Tarasov (1954) have recorded it, as a new record for Russian waters, in the Black Sea. In the eastern North Atlantic it extends to south-west England and South Wales (Norris & Crisp, 1953), though it is absent from the Scilly Isles (Fischer-Piette, 1936). It was not found by Southward & Crisp (1954) in their survey of the intertidal fauna of the Irish coastline but Williams (1954) records it from about 20 m. in Strangford Lough. Occasionally, therefore, it may penetrate far into St. George's Channel. The Scottish record from the Jeffrey's collection (Pilsbry, 1916) is of doubtful validity as is even more so that from Kirkeness in Gruvel (1903).

Darwin hesitated to accept Western Atlantic records for *B. perforatus* and in this he was followed by Pilsbry (1916) on the grounds that they had not been confirmed by later records although Weltner (1897) cites specimens of the var. *angustus* on " *Purpura haemastoma* " from Brazil in the Berlin Museum. Nevertheless there are no recent records of western *B. perforatus* and its occurrence on both sides of the Atlantic must still be regarded as equivocal. The Andaman Islands record in Gruvel (1907*c*) must be in error. The author himself admits that the specimen was scarcely recognisable.

Balanus eburneus Gould 1841

LOCALITY : Accra, on boat buoy, 14.1.51 (2 spec., 1 damaged).

This is the only example of this species in the collection. The intact specimen measures 11·5 mm. carino-rostral diameter as compared with 14–15·5 mm. for material from Woods Hole, Mass., and is therefore not quite full-grown. The specimens are quite typical of *B. eburneus* in shell and valve structure.

This American species has been recorded in the Old World on many occasions since first being reported by Ostroumoff (1892) from Sevastopol, Black Sea. Fischer-Piette & Prenant (1956) have summarized records of *B. eburneus* in the Black Sea and at Istanbul and give many localities on the Atlantic coast of North Spain. Its occurrence in the Adriatic has been reported by Kolosvary (1941*a*, 1944*a*, *b*) and in the Mediterranean by Bishop (1951) and Nilsson-Cantell (1938*a*). Fischer-Piette & Prenant (1957) were surprised not to find *B. eburneus* in Portugal, south-west Spain or Morocco. There are no records for the West African coastline other than the above record from Accra. Its rarity suggests that it is not yet established on the West African coast but is occasionally imported in a breeding condition on ships.

Balanus improvisus Darwin

Balanus improvisus has a vast geographical distribution. Its presence on West European coasts and in the Mediterranean and Black Sea is amply documented, as is its presence on the Atlantic seaboard of North America. In the Tropical and South Atlantic there are a number of records from the West Indies (Darwin, 1854 ; Pilsbry, 1916 ; Henry, 1959) but fewer from the coast of South America, (Darwin, 1854 ; Weltner, 1897 ; Borradaile, 1916) and from West Africa. Broch (1927*a*) recorded *B. improvisus* from Morocco and Gruvel (1907*b*) from the Cape of Good Hope and (1912) from the Congo estuary. It was not present in collections reported on by the writer (1961*a*, *b*, 1963, 1964*a*, *b*). It would appear, therefore, that *B. improvisus* is not common on the west coast of Africa. It is commonly transported by ships and records from estuarine areas such as the Congo, where not collected from ships' hulls, may represent shipborne introductions that have perished, or at least not multiplied greatly. It is evident that *B. improvisus* has not established itself in quantity as it has for instance in the Bosphorus (Neu, 1935, 1939) and in Japan where it has appeared in recent years (Kawahara, 1961, 1963).

Balanus improvisus var. *assimilis* Darwin

This variety of *B. improvisus* occurs in warm water and does not appear north of the Mediterranean whence it has been recorded by Gruvel (1903). It is known from the West Indies (Gruvel, 1903 ; Darwin, 1854 ; Nilsson-Cantell, 1928) and from Brazil (Weltner 1897). In the eastern Atlantic there are records from Mauretania and the Congo (Gruvel, 1912) and Bishop (1951) records specimens on ships coming from West African ports under circumstances suggesting that settlement took place there.

The possibility that white forms of *B. amphitrite* might be confused with *B. improvisus* var. *assimilis* prompted a re-examination of much of the white "*amphitrite*" material to hand. No *improvisus* were found, the white "*amphitrite*" examined all proving to be thin-walled specimens of *B. pallidus* Darwin (= *B. a. pallidus* Darwin). These thin white forms all had opaque white lines opposite the internal ribs of the paries with thin, clear areas between, whereas Darwin expressly states that the translucent areas in *B. improvisus* var. *assimilis* correspond to the longitudinal parietal septa. The identity of the specimens was confirmed by the very long *pallidus*-type spur to the tergum.

There can be no doubt, therefore, that this variety of *B. improvisus* is far from common in West Africa.

Balanus amphitrite Darwin

In considering *B. amphitrite* I have followed Harding (1962) in nomenclature. Hence the Darwinian varieties *venustus*, *pallidus* and *stutsburi* are dealt with separately, the first as *B. venustus* and the other two as *B. pallidus*. The varieties *communis* Darwin, *hawaiiensis* Broch and *denticulata* Broch are combined as *B. amphitrite amphitrite* Darwin.

Balanus amphitrite amphitrite Darwin

Balanus amphitrite Darwin, 1854, 240, pl. 5, figs. 2*e*, *h*, *l*.
Balanus amphitrite hawaiiensis: Utinomi, 1960*a*, 43, text-figs. 1–3.
Balanus amphitrite amphitrite: Harding, 1962, 274, pls. 1, 2.

Localities: Gambia: from seawater intakes of "African Queen", with *B. pallidus* and *B. trigonus* on *B. t. tintinnabulum*, 2.10.51, coll. M. H. Routh, B.M. 1952.10.2.5 (several spec.).

Sierra Leone: Kissy, Sierra Leone River (1) infra-littoral fringe on rocks, 19.7.55, coll. A. R. Longhurst, B.M. 1956.1.7.9 (19 spec.): (2) on bakelite panel exposed 22.3.54–14.6.54, a heavy encrustation (H.G.S.).

Ghana: (1) Ankobra ferry, on logs with *C. dentatus*, 19.2.49 (many spec.); (2) the same, on copper sheathing of boat with epizoic juv. *B. tintinnabulum* (1 spec.); (3) Accra, on boat buoy, 14.1.51 (15 spec.); (4) Labadi, Accra, on gastropod shell; 22.3.58 (9 dead spec.) (H.G.S.); (5) Kpeshie Lagoon, Accra, on oyster shell, coll. D. T. Gauld (38 spec.).

Nigeria: (1) Port Harcourt on hull of launch, (52 juv. spec.) (H.G.S.); (2) Opobo, Imo River, from concrete boat slipway (8 spec.) (H.G.S.).

Considerable confusion has arisen over the identity of the forms variously regarded as varieties or subspecies, *B. amphitrite communis* Darwin (1854), *hawaiiensis* Broch (1922) and *denticulata* Broch (1927*b*) doubtless stemming from the sketchy description of the earliest described. Utinomi (1960*a*) advanced reasons for regarding *hawaiiensis* and *denticulata* as identical, the former name having priority. At the same time Utinomi listed the criteria for distinguishing *B. a. hawaiiensis* from Darwin's var. *communis*.

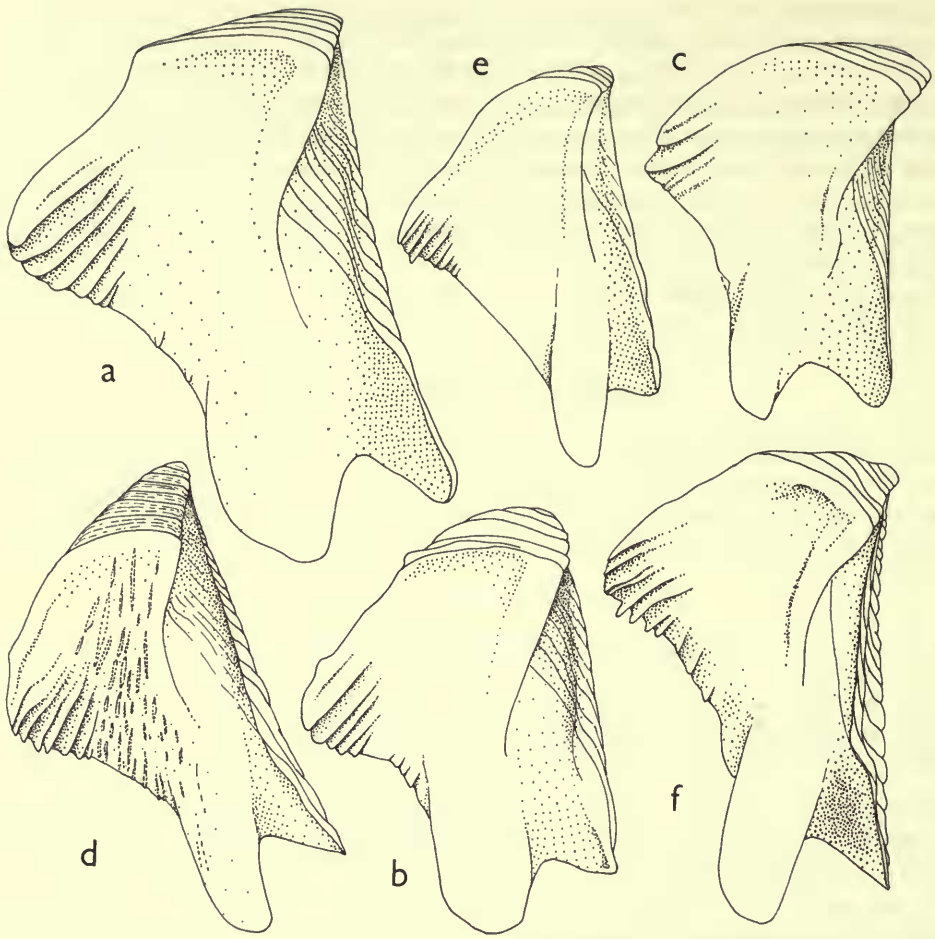

FIG. 14. *Balanus amphitrite amphitrite* Darwin : internal views of terga of six specimens ; *a*, removed from hull of " Atlantide " at Le Havre ; *b*, Kpeshie Lagoon, Accra ; *c*, Labadi, Accra ; *d*, Freetown, Sierra Leone ; *e*, *f*, Lagos, Nigeria (" Atlantide " Sta. 93) ; (*a*, *c* ×28 ; *b*, *d–f*, ×14).

Harding (1962) has given a much-needed re-description of the original Darwin specimens. From this it is evident that the Darwinian var. *communis*, bearing the name in his handwriting, has the characters usually ascribed to *denticulata* or *hawaiiensis* by later authors, and just those listed by Utinomi as typical of *hawaiiensis* and distinguishing it from *communis*. The Darwinian name has clearly become associated with the wrong set of characters, through lack of sufficiently precise information on the original material. Hence, presupposing *communis* and *hawaiiensis* to be distinct, specimens conforming to Utinomi's summary of *hawaiiensis* characters should be termed *B. a. communis* Darwin, or in modern terminology *B. amphitrite* var. or ssp. *amphitrite* Darwin. Those with the characters listed by Utinomi for *B.*

amphitrite communis, if distinct, cannot bear this name but must receive a new varietal or subspecific epithet.

Before taking such action it is prudent to consider whether the apparently clear-cut distinctions between "*communis*" and "*hawaiiensis*" in Utinomi (1960*a*) can be maintained in practice. Material referable to these forms has been gathered from the thirteen localities named below and examined for these supposedly diagnostic characters:

Bathurst, Gambia
Freetown, Sierra Leone
Labadi, Kpeshie Lagoon, Ankobra Ferry } Ghana
Lagos, Nigeria
Zwartkops R., S. Africa
Inhaca Is., Mozambique
Izmir, Turkey
Haifa, Israel
Kuwait
Le Havre, France
Devonport, England

The most clear-cut character, after dissection, is the number of teeth on the labrum. In the 28 specimens examined the smaller numbers found varied from as few as two/three (on the two halves) in a specimen from Lagos to 4 or 5, all widely spread and all on the anterior border close to the edge of the median notch. Only the tooth nearest the mid-line was seated in the notch itself. There was then a jump to 8 or 9, or more teeth, of which many were situated in the notch in the typical close-set "*denticulata*" manner. A clear distinction is evident between a labrum with a few teeth (2 to 5) and another with numerous teeth (8 or 9 or more).

According to Utinomi (1960*a*) the number of parietal tubes in the rostrum is significant, there being about 16 in *denticulata* and only about 9 in *communis*. Using the same specimens, the number of tubes varied from 11 to 21, never as low as nine. The two with only 11 rostral parietal pores had numerous teeth on the labrum. Specimens from all "tube No. categories" had numerous teeth on the labrum. Only "three" (2–5) such teeth occurred in specimens with 12–17 rostral pores. There is no relation between number of rostral pores and number of labral teeth.

The tergal features of spur shape and proportions and number of depressor crests are easy to observe. According to Utinomi in *denticulata* the spur is broad, over one-third the width of the basal margin of the valve, short and rounded or truncate distally, less than its own width from the basiscutal angle. In *communis* it is said to be longer than wide, and separated by its own width from the angle. Utinomi figures both forms (1960*a*, text-figs. 2*a*, *c*) though here the differences are not so marked as some that occur. Forms of "*denticulata*" type tergum occur with a much broader spur (see for instance the lectotype of *B. amphitrite amphitrite* in Harding (1962) pl. 1, figs. *e*, *f*). The length of the spur also is variable. According to Harding (1962) a few of the specimens labelled "*communis*" by Darwin have the tergal spur narrow as figured by him (1854, pl. 5, fig. 21) but the majority of Darwin's specimens have a broad spur. A series of six terga of specimens from various localities (Text-fig. 14) shows this range of spur form. The first two (Text-fig. 14*a*, *b*)

show the broad tergal spur, comparable to that of the lectotype ; in *c* it is reduced in width and in *d* and *e* is so narrow as to be longer than broad. The specimen *f* has a similar narrow spur. Here the margins are roughly parallel and the spur is more sharply marked off from the basal margin of the valve.

Occasionally terga (and scuta) are thin, so that the growth lines are faintly visible internally. More often they are more heavily calcified and are opaque with a smooth internal surface. Roughened areas occur on some terga and rarely may cover the whole internal surface (Text-fig. 14*d*). The depressor muscle crests are very variable in number and development. Five or six well-developed crests appears to be the normal number with one or two very short and ill-defined crests nearer the spur. The outer crest or crests towards the carinal margin of the valve are often less sharply defined (e.g. Text-fig. 14*d*, *e*). Additional small ill-defined crests may be present on the basal margin, e.g. Text-fig. 14*b* and *f*. Text-fig. 14*c* shows a tergum with very poorly developed crests, only two rather low crests being present with very faint traces of a further two inside these.

By plotting the distribution of pairs of characters it is possible to see how far they are linked, even when the separate characters are not expressed numerically. Thus radii with horizontal tops are associated almost exclusively with numerous teeth on the labrum (Text-fig. 15*a*), but oblique radii may be associated about equally with few or numerous labral teeth. There is better correlation between form of radii and form of spur (Text-fig. 15*b*) : a narrow radius with oblique summit appears to be associated exclusively with the longer and narrow tergal spur. A broad spur was not found with this type of radius. But the broad radius with horizontal top is not associated only with a broad spur. In one-third of the admittedly small sample of 12 specimens, the spur was definitely longer than broad. The number of well-developed depressor crests on the tergum (Text-fig. 15*c*) is on average higher (6·43) on forms with narrow oblique radii than on forms with broader radii with horizontal summits (4·9). Similarly the average number of crests is higher where the spur is narrow (*e*) or there are few labral teeth (*f*). A broad spur is almost always associated with numerous labral teeth (*d*) but the converse does not hold (cf. radii and labral teeth in (*a*)). Forms with a narrow-spurred tergum and few or many labral teeth occur with equal frequency.

We can thus pick out a set of features characterizing a " well developed " type of animal, viz : broad radii with horizontal summits, broad tergal spur, numerous labral teeth and 5 depressor crests (or occasionally less) on the tergum. This is, in fact, the result arrived at by Utinomi (1960*a*) and the above features characterize his interpretation of *B. a. hawaiiensis* Broch (= *denticulata* Broch).

The opposite characters—narrow radii with oblique summits, a narrow and longer tergal spur, and few teeth on the labrum and more than 5 depressor crests on the tergum also occur in association. These are the characters, again among others, listed by Utinomi for *B. a. communis* Darwin. But, as the diagrams in Text-fig. 15 indicate these associations are not constant—a narrow tergal spur, or narrow radii occur as frequently associated with numerous labral teeth. Hence, specimens occur with a " mixed " assemblage of characters and the question arises as to which of these must be regarded as determining the name to be assigned to the specimen. Of the

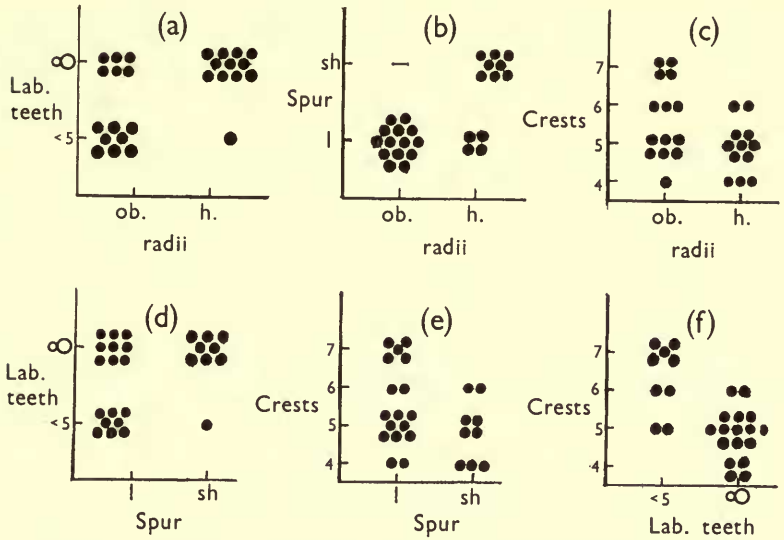

FIG. 15. Frequency of occurrence of various pairs of characters in *B. amphitrite amphitrite* Darwin, namely: radii with oblique (ob) or horizontal (h) summits; tergal spur short and broad (sh) or longer and narrow (l); number of depressor muscle crests on tergum; and labral teeth five or less, or numerous.

26 specimens examined in detail no less than eight were in this mixed category. The mixed range of characters found is typified by the following examples:

(1) Kpeshie lagoon, Ghana (Text-fig. 14*b*): radii broad, horizontal summits: tergal spur broad, 5 tergal crests (= "*denticulata*"), *but* labral teeth only 4/5 on the two sides.

(2) Bathurst, Gambia: radii narrow, tergal spur long and narrow (= *communis*) *but* tergal crests 4 and labral teeth numerous (= *denticulata*).

(3) Four specimens from the same Lagos gathering had the following characters: radii narrow, with oblique summits, spur narrow, and (*a*) tergal crests 5: labral teeth 8 or 9. (*b*) tergal crests 5: labral teeth c. 12. (*c*) tergal crests 6/7[1]: labral teeth 3. (*d*) tergal crests 5 (+1)[2] labral teeth 2/3.

Specimens 3 (*a*) and (*b*) are anomalous, (*c*) and (*d*) are assignable to "*communis*". The first two were white-shelled and without pigment, a character not quoted by Utinomi for either group. The second two have shells with a pinkish or flesh tint and pale purplish lines, which fits with Utinomi's description.

The colour of the shells calls for comment. Utinomi characterizes "*hawaiiensis*" as having a glossy white shell with dark violet longitudinal stripes, some being reduced or absent: "*communis*" is regarded as "rather reddish white, darkened with bluish tint in upper part" with "pale or dark violet longitudinal stripes crossed by the same, coloured or reddish transverse stripes on the whole area". At least as far as the Mediterranean and West African specimens are concerned, this also is a

[1] 6/7 etc. on the two valves or sides of labrum.
[2] 5 (+1), 5 crests + 1 rudimentary crest.

perfectionist view. I have seen East African specimens with near white shell and the dark pigmented (purple rather than violet) lines arranged as described. But West African shells most often bear only pale stripes of a dull faded purple or pale reddish colour, the latter often regularly interrupted by still paler horizontal lines. Vertical lines may be absent from one or more sectors of the paries regardless of intensity of line colour. In a considerable proportion of shells all colour is absent. I cannot agree that all specimens can be resolved into those with dark lines interspersed with white sectors and those with regularly arranged paler or interrupted lines and no white sectors. Too many lightly pigmented specimens have white shell sectors.

There is thus a high proportion of specimens ostensibly with characters of both varieties or subspecies, and which cannot readily be assigned to one or the other. Each of these same characters varies in degree of development, so that for many of them there is a complete gradation from one varietal form to the other. Thus it becomes difficult, if not impossible, not only to place many specimens in a " variety " but also to state categorically to which varietal type a particular character may be assigned. Under these circumstances it is preferable to regard the various characters described as randomly variable within the " *communis* "–" *hawaiiensis* " complex and not segregating in a clear cut manner such as to allow of the characterization of true varieties.

Within purely local populations a greater uniformity may prevail. The encrustation of specimens on a panel exposed at Freetown is of this type. There is considerable uniformity among individuals. But these are from one small locality and all living at one time (within a 3-month period). This resemblance among individuals of a group collected in one place appears usual—but it does not apply automatically to specimens from other places, even those nearby, or to collections at other times.

It is, therefore, preferred, to regard the West African *B. amphitrite*, previously described variously as *communis*, *denticulata* or *hawaiiensis* as one rather variable form only, to which the name *B. amphitrite amphitrite* Darwin is applicable.

B. amphitrite amphitrite occurs as far north as the western English channel in places where conditions are exceptionally favourable. It occurs intermittently on the Atlantic coasts of France and the Iberian peninsula (Bishop, Crisp, Fischer-Piette & Prenant, 1957). It appears to be absent from the Straits of Gibraltar and to occur intermittently on the Spanish shore of the western Mediterranean (Barnes & Barnes, 1964). Utinomi (1959*a*) does not record it from Banyuls nor from the coast of Algiers (1959*b*) but the material recorded in the latter paper is all from off-shore, so the absence of this shore or shallow water species from Algiers is not proven. Broch (1927*a*) likewise, does not report it from the Atlantic coast of Morocco.

The same intermittent occurrence, usually in very small numbers is found on the west coast of Africa and in the off-shore islands. It occurs in the Canary Islands (Stubbings, 1963) but was not found in the Cape Verde Islands (Stubbings, 1964*a*) or in the islands of the Gulf of Guinea (Stubbings, 1961*b*). On the African mainland there is a record from Port Etienne, Mauretania (Broch, 1924*a*) and others from Senegal (Stubbings, 1965) Gambia (Stubbings, 1961*a*) Portuguese Guinea (Stubbings, 1965) and Sierra Leone. On this extreme western sector of the West African coast

it appears at its most abundant. It is particularly common in the Sierra Leone estuary. Further east and south there are a few records of small numbers from Ghana and Nigeria and one record of a group of specimens from Angola (Stubbings, 1964*b*).

Balanus amphitrite var. ***albicostatus*** Pilsbry

B. a. albicostatus Pilsbry, 1916, 90, pl. 20, figs. 1–4.
B. a. albicostatus: Kolosvary, 1943, 84.

This variety, originally described from Far Eastern specimens has been recorded once from the Mediterranean (Catania) and once from Senegal, West Africa, (Kolosvary, 1943*a*) but from nowhere else on the Eastern Atlantic seaboard. In view of the large amount of West African barnacle material now available the lack of later records casts doubt on this earlier record and the status of *B. a. albicostatus* as a member of the West African fauna is suspect.

Balanus pallidus Darwin

Balanus amphitrite var. (3) *pallidus* Darwin, 1854, 240, pl. 5, figs. 2*c*, *k*.
Balanus amphitrite var. (6) *Stutsburi* Darwin, 1854, 240, pl. 5, figs. 2*d*, *i*, *m*, *n*, *o*.
Balanus dybowskii Gruvel, 1903, 143–8, pl. 1, figs. 1–9 ; pl. 4, fig. 14.
Balanus pallidus pallidus: Harding, 1962, 278, pl. 3.
Balanus pallidus stutsburi: Harding, 1962, 281, pl. 4.

Localities: Gambia: from sea-water intake of " African Queen ", pure white shells on *B. tintinnabulum* with a few *B. trigonus* and *B. amphitrite*, 2.10.51, pres. M. H. Routh, B.M. 1952.10.2.5 (numerous spec.).

Sierra Leone: (1) Sierra Leone River, 20 m., 5.12.54, coll. A. R. Longhurst, B.M. 1956.1.7.6; (2) S. Leone River, 2 clusters 13.10.54, coll. A. R. Longhurst, B.M. 1956.1.7.8 (10 + 5 spec.); (3) Kumrabe Creek, S. Leone River, 2 m., on *Pachymelania aurita*, 2.12.52, coll. A. R. Longhurst, B.M. 1956.1.7.7 (1 spec.).

Ghana: (1) R. Densu on mangrove 0·5 mile from sea, 3.4.49 (53 spec.); (2) on launch " Akuse ", Ada, R. Volta, 15.3.49 (193 spec.); (3) on stranded pontoon, Ankobra, 19.2.49 (several dead spec.); (4) Christiansborg, Accra, 19.11.49 (1 dead spec.); (5) Chorkor, Accra, –.3.49 (12 spec.)

Nigeria: (1–4) Lagos: (1) from test panels, Tarquah Bay, 19.10.57 (56 juv. spec.) (H.G.S. 235); (2) the same, 21.10.57 (218 spec.) (H.G.S. 240); (3) the same, 21.6.54, coll. T.T.E. staff (7 spec.); (4) Wilmot Point, n.d., coll. T.T.E. staff (27 + 17 dead spec.); (5–19) Port Harcourt: (5) police wharf, 11.9.57 (5 spec.) (H.G.S. 156); (6) raft, 19.9.57 (12 spec.) (H.G.S. 179); (7) raft, 28.9.57 (5 spec.) (H.G.S. 200); (8) raft, 9.10.57 (30 spec.) (H.G.S. 217); (9) raft, 5.11.57 (21 spec.) (H.G.S. 283); (10) raft, 21.11.57 (94 spec.) (H.G.S. 307); (11) raft, no data (13 spec.); (12) on mangrove roots, 29.10.57 (33 spec.) (H.G.S. 252); (13) on steel launch, 28.10.57 (52 juv. spec.) (H.G.S. 257); (14) from test-frames on " dolphin ", 6.10.55 coll. T.T.E. staff (7 spec.); (15) on *Ostrea* sp. on " dolphin ", 20.11.57 (9 spec.) (H.G.S. 294); (16) the same, 19.12.57 (42 spec.) (H.G.S. 348); (17) on " dolphin ", 19.12.57 (46 spec.) (H.G.S. 349); (18) on *Ostrea* sp. on " dolphin " 19.12.57 (4 spec.) (H.G.S.

342); (19) on " dolphin " 18 in. above extreme L.W. 19.12.57 (4 spec.) (H.G.S. 351); (20) Nigerian Ports authority, dockyard pier, 11.12.57 (89 spec.) (H.G.S. 329); (21–26) Bonny River Buoys: (21) between Dawes I. and Port Harcourt, 30.10.57, (43 spec.) (H.G.S. 259); (22) No. 2 buoy, 11.12.57 (4 spec.) (H.G.S. 327); (23) No. 3 buoy 11.12.57 (1 spec.) (H.G.S. 339); (24) the same (5 spec.) (H.G.S. 340); (25) No. 4 buoy, on *B. tintinnabulum*, 11.12.57 (4 spec.) (H.G.S. 402); (26) No. 5 buoy, 14.12.57 (8 spec.) (H.G.S. 342); (27–29) Bonny: (27) old iron pier, 28.11.57 (27 spec.) (H.G.S. 320); (28) the same (17 spec.) (H.G.S. 322); (29) new concrete pier, 28.11.57 (32 spec.) (H.G.S. 324); (30–32) Opobo, in Imo River; (30) 9.8.53, coll. T.T.E. staff (many spec.); (31) on jetty, 11.1.58 (53 spec.) (H.G.S. 373); (32) on Eastern Region Development Commission concrete boat slip, 31.1.58 (8 spec.) (H.G.S. 372); (33) Oron, Cross River, on *Thais* sp. and *Brachiodontes niger*, 17.2.54, coll. T.T.E. staff (numerous spec.).

Cameroon : Bota, Ambas Bay, on concrete boat slip, 21.2.58 (1 spec.) (H.G.S.) 428).

The Darwinian varieties *B. amphitrite* var. *pallidus* and var. *stutsburi* are included under this name. A great deal has been written on the variability of form and the status of these two varieties.

The identity of *B. dybowskii* Gruvel with *B. a. pallidus* was recognized earlier (Stubbings, 1963). Suffice it to say here that many of the estuarine samples, notably those from Opobo on the Imo River contain *dybowskii*-like specimens. The absence of radii is due to heavy erosion of specimens with originally narrow or rudimentary radii. Apart from surface erosion the apices of compartments are much worn down so that the shell becomes a low eroded calcareous ring with no external features.

The extent of pigmentation of *B. pallidus* varies from complete coverage of the compartments, through intermittent horizontal bands of colour to a single narrow band on either side of the paries of a compartment and finally to a complete absence of the purple pigment. In any gathering of specimens from a locality there is considerable colour variation often extending from wholly white specimens to those with much colour. Completely pigmented specimens such as that figured by Darwin (1854, pl. 5, fig. 2*d*) as var. *stutsburi*, are not common. Miss Sandison (1962, 541) found that white compartments were more common in barnacles that settled during the dry season and purple-marked shells in those that settled in the wet season. Colour is thus a matter of seasonal growth, and probably of food supply, as Miss Sandison suggests, and is of no systematic significance.

The shapes of terga from several sites in Nigeria have been illustrated by Miss Sandison (1962, text-fig. 4). A further selection of terga from Gambia, Ghana and two sites in Nigeria is shown in Text-fig. 16. The Bathurst, Gambia specimen (Text-fig. 16*a*) is similar to her Port Harcourt example, whilst the present Port Harcourt specimen (Text-fig. 16*e*) is more like her Tiko, Cameroon specimen in its narrow spur and its basal emargination. The Tarquah Bay, Lagos specimens (Text-fig. 16*c*, *d*) are very like her lower Lagos tergum except that the spur is narrower and slightly hooked. Tarquah Bay is situated at the seaward end of Lagos harbour.

There is a similar range of variability in the scuta and specimens paralleling those shown by Miss Sandison (1962, text-fig. 5) are not difficult to find.

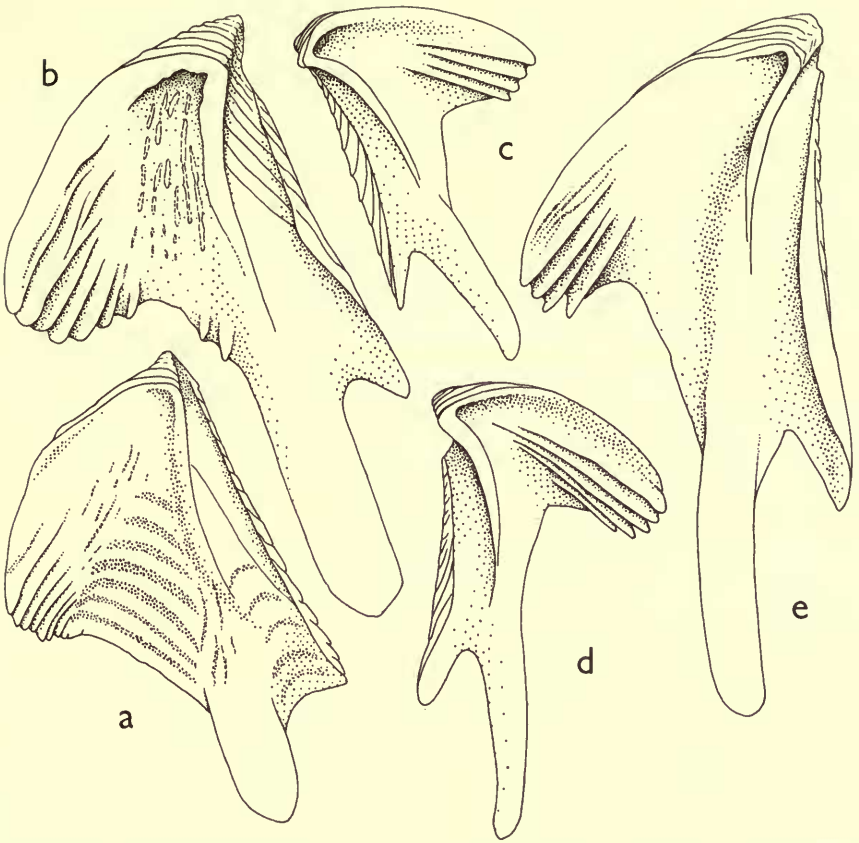

FIG. 16. *Balanus pallidus* Darwin : terga of five specimens ; *a*, from Bathurst, Gambia (" Atlantide " Sta. 155) with rather short spur and straight basal margin ; *b*, from Ada, R. Volta, Ghana (coll. R. Bassindale) with long, stout spur and some excavation of basal margin ; *c*, *d*, two lightly calcified thin specimens from Tarquah Bay, Lagos, Nigeria (coll. H.G.S.) with long slender spur and deeply excavated basal margin ; *e*, a more heavily calcified specimen than the preceding from the mooring " dolphin " at Port Harcourt, Nigeria, (coll. H.G.S.), with long, stouter spur and concave basal margin (all ×14).

B. pallidus is the predominant species in all the estuaries, extending from the river mouth well up the rivers where salinity may be reduced very considerably during the rainy season. At Port Harcourt, for instance, where *B. pallidus* is always present, the salinity falls to 12‰ or slightly lower late in the rains. Where salinity falls very low, however, *B. pallidus* is seasonal only, as in Lagos Harbour (Sandison, 1962). Its absence from the Cross River at Calabar (Sandison 1962 and personal observation) is explanable on low salinity, for the river there is virtually fresh at all times. In February, 1958, a salinity of only 0·01‰ was recorded (personal observation). Lower down the Cross River, at Oron, it occurs as in other and smaller estuaries.

B. pallidus is rare on the open coasts. The single specimen recorded above from

Christiansborg, Accra, is exceptional. It was dead and may well have been carried by the tide and surf from elsewhere.

Miss Sandison (1962) noted that east of Accra the only suitable area for *B. pallidus* should be the mangrove areas of the Volta estuary. Gauld (1957) had already recorded it from Angaw Creek in that area and the present record from Ada confirms this locality. West of Accra we now have records from the estuaries of the rivers Densu and Ankobra.

On the West African coast as a whole, *B. pallidus* is known from Fedhala, Morocco (Broch, 1927) to the Congo estuary (Weltner, 1922 ; Nilsson-Cantell, 1938*b* ; Stubbings, 1963). There is a record of a single specimen from the Cape Verde Archipelago (Stubbings, 1964*a*) but the species appears to be rare there.

Balanus venustus venustus Darwin 1854

Balanus amphitrite var. (2) *venustus* Darwin, 1854, 240, pl. 5, fig. 2*a*.
Balanus amphitrite var. 2, *venustus;* Weltner, 1897, 265.
Balanus amphitrite var. *venustus;* Gruvel, 1903, 137.
Balanus amphitrite var. *venustus;* Annandale, 1906, 147.
Balanus amphitrite f. *venustus;* Broch, 1924*a*, 203, 204.
Balanus amphitrite venustus; Nilsson-Cantell, 1932*a*, 110.
Balanus amphitrite venustus; Nilsson-Cantell, 1938*a*, 37, text-fig. 8.
Balanus amphitrite venustus; Neu, 1939, 210.
Balanus amphitrite f. venustus; Gauld, 1957, 10.
Balanus venustus venustus; Harding, 1962, 283, pl. 6.
non Balanus amphitrite var. *venustus;* Gruvel, 1912, 346.
nec Balanus amphitrite venustus; Nilsson-Cantell, 1925, 28, pl. 1, fig. 3, text-fig. 11.
nec Balanus (s. str.) *amphitrite venustus;* Tarasov & Zevina, 1957, 189, text-fig. 74.

Localities: Ghana: (1–53) off Accra, Stas. 1, 2, 5, 6, 8–12, 14–17, 19, 21, 23, 27, 29–33, 53, 55–57, 59, 61–63, 67, 68, 70, 81, 83, 85–87, 93–96, 98, 99, 104, 106, 107, 121, 124–126, 129, 130; (54) Chorkor, Accra, in " bottom nets "; (55) Winneba; (56) off R. Densu; (57) Prince's Town; (58) Accra, 18–27 m., on *Turritella* sp. coll. R. Bassindale, B.M. 1953.2.5.2 (several spec.); (59) trawled off Accra, with *C. patula* on *Cymbium porcinum* pres. E. Salzen, B.M. 1957.6.3.1 (46 + 29 juv. spec.).

Nigeria: Lighthouse Beach, Lagos: (1) on cork cast up on beach, with *B. t. tintinnabulum* and *C. patula* (several dead spec.); (2) on a stone cast up on beach, with a Gorgonian (1 spec.).

To avoid excessive repetition in listing the records of this very abundant species the stations off Accra made by Mr. Bassindale have been cited above by number only. Fuller station details are given in Tebble (1955) and Bassindale (1961). Specimens have been collected from shells of the following Mollusca and Crustacea :

Gastropoda: *Turritella annulata* Kiener, *Solarium granulatum* Lam., *Crepidula porcellana* Lam., *C. porcellana* var. " Garnot " Adanson, *Natica collaria* Lam., *N. fulminea* Gmelin, *Murex hoplites* P. Fischer, *M. bourgeoisi* Tournouer, *Phos grateloupianus* Petit de la Saussaye, *Nassa tritoniformis* Kiener, *N.* cf. *plicatella* A. Adams, *Fusus boettgeri* v. Maltzan, *Olivancillaria* (*Agaronia*) *hiatula* Gmelin, *Cymbium porcinum* Lam., *Cancellaria cancellata* Linn., *Drillia rosacea* Reeve, *Clavatula muricata* Lam., *C.* (*Pusionella*) *nifat* Adanson, *Surcula coerulea* Weinkauft, *Turris pluteata* Reeve, *T.* (*Crassispina*) *carbonaria* Reeve, *Genota mitraeformis* Wood,

Terebra senegalensis Lam. **Lamellibranchiata** : *Cardium costatum* Linn., *C. ringens* Gmelin, *Dosinia africana*, Gray. **Crustacea** : *Balanus tintinnabulum* var. *tintinnabulum* (Linn.), *Apiomithrax bocagei* (Osorio), *Calappa rubroguttata* Herklots.

The references in the literature to *B. amphitrite* var. *venustus*, Darwin by name are listed above. That they all refer to this variety is doubtful as discussed below. Weltner's record (1897) from Nagasaki was questioned by Nilsson-Cantell (1932*a*) presumably on account of its geographical separation from other records, as no morphological questions were raised.

There are only five illustrations of the variety in the literature. One, (Tarasov & Zevina, 1957) is a copy from Nilsson-Cantell (1925) which is not here considered to be var. *venustus*. There are thus only three valid illustrations ; of the whole shell (Darwin, 1854, pl. 5, fig. 2*a*), of a scutum and tergum (Nilsson-Cantell, 1938*a*, text-fig. 8) and of shell, opercular valves and appendages (Harding, 1962). Darwin's illustration of the hard parts of his varieties of *B. amphitrite* were not complete, which has undoubtedly led to some difficulty and misunderstanding of the varieties he proposed. Opercular valves of *venustus* are present in the Darwin collection of Cirripedia in the British Mudeum (Natural History) and these have been redescribed and figured by Harding (1962). The spur of the tergum is short and broad. This with the characteristic pink colour of the shell will in general distinguish the variety.

From the very extensive Ghanaian material it is possible to give an extended description of the variety. The shell is typically pink, sometimes bright but more often rather dull or " washed out ". Pale pink specimens also occur, but the shell is never red and only rarely approaches the purplish pink, of deeply coloured *B. pallidus*. Narrow vertical stripes of a deeper pink are present on the paries but may be absent or difficult to distinguish from the ground colour. Rarely the pink stripes are the only colour present (cf. some var. *stutsburi*). Shells with an orange tint occur rarely among normal pink ones.

From the many young specimens present it is evident that for some time after metamorphosis the shell of *B. venustus* is white. Pink pigment is developed quite suddenly as there is a rapid transition from white to pink shell. Young specimens thus have shells pink basally and with white summits to the compartments. The age, or size, at which pigment is first produced is very variable and a few never do so and remain pure white. When pigment is produced early in life, older specimens may be completely pink-shelled due to the disintegration of the tops of the compartments. Rarely, specimens occur with pigment on the margins of the paries only. When rather elongated these tend to resemble the *B. amphitrite* var. *pallidus* of Darwin. Such a specimen was found in the R. Densu collection listed above. It had a typical *B. venustus* tergum as here described.

The compartments are smooth or irregularly folded. Smooth specimens tend to be less heavily calcified and somewhat translucent so that the septate parietal canals are visible externally. The radii are moderately developed or narrow with very oblique summits when intact, white above and pink below. When intact the orifice is highly dentate. The epidermis is thin and not persistent. It bears horizontal rows of short fine hairs corresponding to the growth increments. Alae are well developed with less oblique summits than the radii. Internally the growth lines

are prominent on alae and sheath. The sheath is overhanging, about one-third to one-half the length of the compartment. The compartments are prominently ribbed internally.

The scuta of three West African specimens are illustrated (Text-fig. 17*a*, *c*, *e*). The tergal and basal margins are of equal length, the basal angle being rounded off so that the slightly convex basal margin curves into the tergal. Growth lines are distinct but not prominent, the epidermis persistent in part and with hairs along the growth lines. The apex is acute when uneroded. There is a purple patch in the upper part of the valve but the apex is usually colourless. Rarely the whole scutum

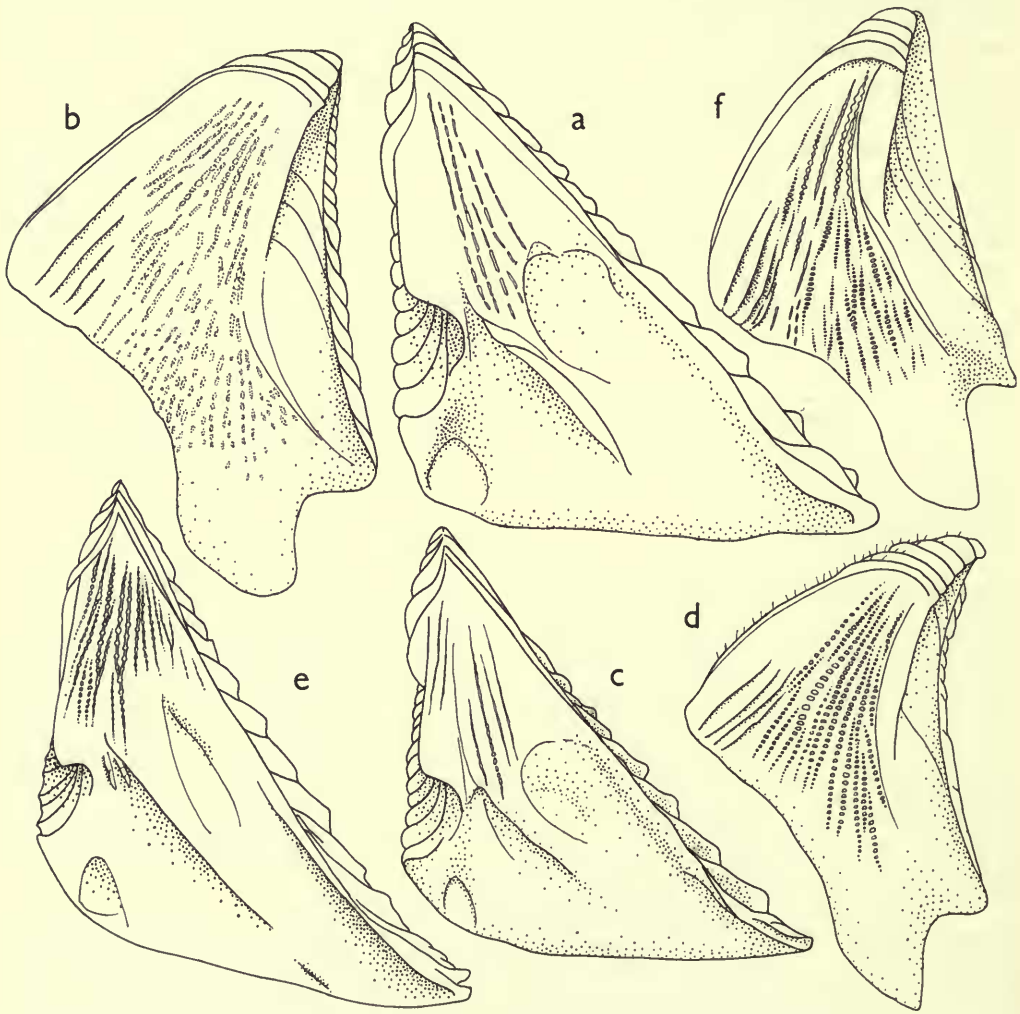

FIG. 17. *Balanus venustus venustus* Darwin. Internal views of the paired scutum and tergum of three specimens from off Accra : *a*, *b*, from Sta. 17 ; *c*, *d*, from sta. 31 ; *e*, *f*, from sta. 87 (*a–d* ×27 ; *e*, *f* ×14).

is colourless. There is no direct relationship between shell pigmentation and that of the opercular valves ; of two shells with virtually identical pigment development, one may have a very small pale purple patch on the scutum and the other a deep purple patch covering the apical third of the valve. Very young colourless shells have colourless scuta. The outer surface is faintly striated from the apex. Internally the valve is thick with a prominent adductor ridge. The deep groove below the ridge and the deep depressor muscle pit between them delimit a raised area that in some specimens has the appearance of a low broad ridge. There is not a true second ridge. The adductor muscle pit is large and distinctly marked. The articular ridge is large, straight and reflexed over the articular groove. The inner surface of the valve is faintly striate in the area above the adductor ridge. The striations extend on to the articular ridge.

The terga corresponding to these scuta are illustrated in Text-fig. 17*b*, *d*, *f*. The valve is flat, triangular with a short broad spur about one third the width of the basal margin. Growth increments are marked by distinct grooves externally. The spur area also is demarcated by grooves only. The articular margin is slightly concave, the carinal margin convex, the basal margin on the carinal side straight or more usually slightly concave. Internally the articular ridge is long but not very prominent, the articular groove long and deep. Crests for the depressor muscle are only feebly developed and about four in number. The internal surface is more or less striated longitudinally, the striations being finely tuberculated.

The above descriptions of scutum and tergum are in close agreement with the figures given by Harding (1962, pl. 6, figs. *d–g*) for the lectotype of *B. venustus venustus*.

Opercular valves of " *venustus* " have been figured by Nilsson-Cantell (1925, 1938*a*), the two figures representing very differently shaped valves. The Indian specimens (Nilsson-Cantell, 1938*a*), have valves similar to those shown here though there are some differences. Thus the scutum has a basi-tergal angle of $< 90°$ and the corner of the valve is not rounded off : also, the articular ridge projects a little in front of the valve margin. The tergum is more angularly triangular mainly due to the very straight carinal margin. In other respects these valves appear to agree reasonably with the West African *venustus*.

The variety figured by Nilsson-Cantell (1925) has very different valves. The tergum has a long narrow spur and many crests for the depressor muscles. The shell is said to be red (" rot ") and the colour to agree best with that of *venustus*. But no *venustus* in the present collection from West Africa is red. The statement that the stripes are not confluent—a character attributed to *stutsburi*—is not valid as *stutsburi* has often clear distinct stripes. In the scutum the depressor muscle pit is said to be indistinct (" unbedeutend "), which is not the case for *venustus* as here considered. It is considered that the specimens are referable to Darwin's var. *Stutsburi*, i.e. *B. pallidus* Darwin of this work.

Excluding the rejected figures given by Nilsson-Cantell (1925) and copied by Tarasov & Zevina (1957) there were no illustrations or valid descriptions of the appendages of *B. venustus* until Harding (1962) published photographs of a lectotype from Natal. The mouth-parts of a specimen from Accra are described and figured

here. The labrum (Text-fig. 18*a*) has the two halves of the margin set at an angle so that the median toothed area is prominent. There are two or three teeth on either side of the wide V-shaped notch. Sparse short hairs are present round the teeth and in the upper part of the notch. Hairs are absent in Harding's photograph (1962, pl. 6*c*). The palp (Text-fig. 18*b*) is rectangular, tapering slightly towards the rounded extremity. The anterior margin is slightly concave, the posterior convex. The hairs on the concave margin are short. A band of similar short hairs on the inner face of the palp merges into the long hairs of the extremity. A row of long hairs begins on the face, runs to the posterior margin of the palp and follows this margin to merge with the apical hairs.

The mandible (Text-fig. 18*c*) has five teeth, the third to fifth lying close together. The first is normally simple but occasionally bifid at the tip. The second is simple or with a small cusp which when close to the tip renders this bifid. The third to fifth teeth are usually blunt from use but in the developing cuticle are sharp. The third tooth has one or two secondary cusps but occasionally may be simple. The

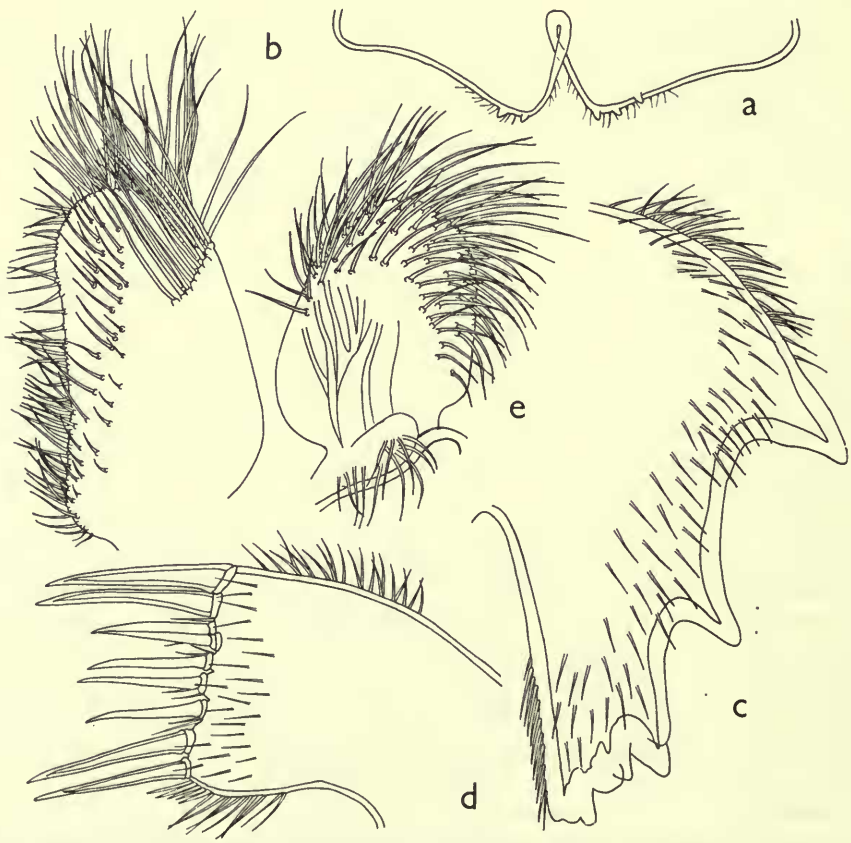

FIG. 18. *Balanus venustus venustus* Darwin. Mouth parts of a specimen from Sta. 87 off Accra. *a*, labrum (×58); *b*, palp (×45); *c*, mandible; *d*, maxilla I (both ×100); *e*, maxilla II (×45).

fourth is double with two sharp equal points when new but usually worn down in use. The fifth is very close to the lower angle and when worn apparently confluent with it. In the developing cuticle it is distinct and there are two sharp stout spines below it on the lower angle. Harding's illustration (pl. 6*n*) would appear to be of a worn mandible as the lower angle is blunted.

Maxilla I (Text-fig. 18*d*) has a straight biting edge. The lower pair of spines is about as large and stout as the upper pair. There are five intermediate spines, though occasionally four or even only three. There is a small tuft of short stout hairs or fine spines on the lower angle. Of six pairs of maxillae examined, in two there was a difference in number of intermediate spines in the left and right maxilla.

Maxilla II (Text-fig. 18*e*) is broadly oval tapering slightly to the tip, which is densely clothed with long fine setae. There is a very small lower lobe.

Cypris larvae were present on some mollusc shells. Two from a valve of *Cardium ringens* measured

0·75 mm. long	× 0·31 mm. high	× 0·27 mm. broad
0·73	× 0·30	× 0·26

and a third unattached specimen was 0·676 mm. long.

The present material comes entirely from below low-tide level. According to Buchanan (1958) *B. venustus* is a common member of the sessile epifauna of the " inshore fine sand " and " sandy silt " communities off Accra, i.e. from 3–20 fathoms (5·5–36·5 m.) depth. The present collections show it to be abundant from 10–20 m. and rather less common from 20–25 m., that is over the deeper part of the fine sand community and the shallow part of the sandy silt community. Here it is abundant on shells of *Cardium ringens* Brug. and especially *Turritella annulata* Kiener, both living and dead. As many as 74 specimens, all but three alive, were found on a single *Turritella* shell. It is by no means confined to these molluscs as the extensive list above testifies. The two records of material cast on shore at Lagos suggest that *venustus* occupies a similar habitat there. Shallow water dredgings in the Bonny estuary, Eastern Nigeria, failed to obtain this variety. Records from the " Atlantide " and " Calypso " Gulf of Guinea expeditions (Stubbings, 1961*a*, *b*) indicate that *B. venustus* is distributed from Gambia to the R. Congo. The fact that most specimens from the latter locality came from 25 m., or deeper and were dead, suggests that the normal habitat of *B. venustus* is in the 10–20 m. depth zone.

A number of specimens from Accra Sta. 2 were attached in the grooves on the convex side of *Cardium ringens* valves. All were orientated along the grooves and elongated along the rostro-carinal axis, with the carinal end directed towards the highest part of the shell. Thus the few barnacles in the shallower part of the grooves near the umbo were orientated at 180° to the majority in the deeper furrows nearer the shell lip.

B. venustus was not obtained from the intertidal zone by either of the above expeditions, nor by Bassindale or the author. Neither was it found on mangrove roots, a common habitat of estuarine species in West Africa. It is evidently confined to the open sea. This is of significance in that it supports the view that the form found by Gruvel (1912) on mangroves in the lagoon at Grand Bassam, Ivory Coast,

and that reported by Nilsson-Cantell (1925) on mangroves from the Cameroons, are not *venustus*. The mangrove fringed estuarine creeks of tropical West Africa are the habitat of *B. pallidus* Darwin.

B. venustus appears to be very widely distributed in tropical waters. Whereas now it is perhaps best known from West Africa it is also found in S. Africa (Darwin), Ceylon (Annandale, 1906) India (Nilsson-Cantell, 1938*a*). Weltner's record from Nagasaki (Japan) has already been noted as doubtful (Nilsson-Cantell, 1932*a*). That it has not been recorded by Hiro (Utinomi) from Japan confirms this doubt. This absence from the literature on Far Eastern barnacles casts further doubt on the record by Tarasov & Zevina (1957).

Balanus venustus niveus Darwin

Balanus venustus niveus: Harding, 1962, 286, pl. 7, figs. *a–r*.
Balanus venustus niveus: Stubbings, 1964*b*, 340.

A number of more or less translucent white "*B. amphitrite*" from the Sierra Leone river, Port Harcourt and Bonny, Nigeria, were at first assigned to this variety. A further examination cast doubts upon this determination. In the first place all the specimens were associated with more or less pigmented *B. pallidus*. A more detailed examination after removal of epizoic growth and debris from the compartments and opercular valves showed that an appreciable number had slight traces of pinkish-purple pigment, either as small streaks or spots on the body of the paries or as small marginal lines. Patches of pigment were present also on the scuta, though smaller than on well-pigmented individuals. As no pigment is recorded for the Darwin type of var. *niveus*, it seemed probable that these specimens were really very poorly coloured *pallidus*.

In typical specimens, of course, the tergum of *pallidus* is very distinctive having a long spur and much emarginated basal margin whereas that of *niveus* is short and broad and obliquely truncated In the terga of the specimens in question the spur is not typical of either form, being shorter than in *pallidus* but less broad in proportion than in *niveus*. They could be regarded as rather atypical specimens of either variety. As, however, pigmented specimens in the same collections had similar terga it is considered that the whole sample in each case belonged to one variety and the material is all regarded as *B. pallidus*.

There is not, therefore, any material in the collections under review that can be assigned with certainty to *B. venustus niveus*. In all the West African collections examined by the author with one exception, *B. v. niveus* has been absent. In material from the Congo estuary (Stubbings, 1964*b*) a few specimens were found which appeared to belong to this variety. As concluded in that report, *B. v. niveus* is very rare in West African waters and may well occur sporadically as a shipborne immigrant.

The above record from the R. Congo is the only one from the eastern Atlantic though Kolosvary (1951) cites the Mediterranean and Darwin (1854) South Africa. Neither record has been confirmed. Further afield there are a number of scattered records of *niveus* from the Indian Ocean and the Malay Peninsula. As the variety is

common on the American shores from Massachusetts to Southern Brazil and according to Kolosvary (1943*a*) occurs at Montevideo, Uruguay and even in Tierra del Fuego, there is ample scope for shipborne transport of this variety as with other forms of "*B. amphitrite*" and some at least of these scattered records may represent such local introductions.

Balanus fallax Broch

Balanus (*Hesperibalanus*) *fallax* Broch, 1927, 26, pl. 2, figs. 12–17 ; pl. 3, figs. 18, 19 ; text-figs. VII–IX.
Balanus (*Hesperibalanus*) *fallax:* Utinomi, 1959*b*, 402, text-fig. 1.
Balanus occidentalis Stubbings, 1961*a*, 34, text-figs. 8–11 ; 1961*b*, 189.
Balanus fallax: Stubbings, 1963, 30, text-figs. 10, 11.

Localities: Ghana: Accra, (1) Sta. 133, 51 m. (1 spec.); (2) 14 m., in sponge, 27.4.51 (1 spec.); (3) Osu Fisheries Sta., 19.5.51 (4 spec.); (4) near R. Densu, 15 miles from Accra, 16.5.51 (1 spec.).

The above material has been compared with the original material designated as "types" by Professor Broch. The shell and appendages have been redescribed in some detail (Stubbings, 1963) and it is only necessary here to comment on points of interest in the Ghanaian material.

The specimens exhibit in general a more strongly developed shell. That from 14 m. in a sponge is mottled pink like the type material but the others have regular lines of pigment except towards the margins of the compartments where the lines are broken up into blotches or spots of a deep pink colour. None of the specimens shows longitudinal striations on the scuta.

The internal sculpturing of the scuta is strongly developed (Text-fig. 19*a*, *c*, *e*). The adductor scar is a distinct pit deepest on its apical border. There is no adductor ridge but the valve is appreciably thickened below the adductor pit. In the specimen from the R. Densu (Text-fig. 19*e*) there is a faint suggestion of a short ridge parallel to the basal margin immediately below the adductor pit. The pit for the lateral depressor muscle is more marked in these somewhat heavier valves. The basitergal angle according to Broch (1927*a*, figs. 16, 19) and Stubbings (1963, fig. 10) is 90° or more. In one specimen (Text-fig. 19*c*) this angle is less than 90° though in another specimen (Text-fig. 19*e*) the angle is distinctly obtuse.

A point not brought out in Broch's figures is the scroll-like form of the upper part of the articular ridge of the scutum. This is well marked in the specimens here illustrated. The degree of development of this scroll affects the shape of the lower end of the articular ridge. If the scroll is weak, as in Broch's illustration and Text-fig. 19*e*, then the ridge ends abruptly. But when the scroll is strongly marked (Text-fig. 19*a*, *c*) then it extends to the lower part of the articular ridge and the ridge ends less abruptly, curving into the plane of the valve.

Terga from two barnacles from Osu are shown in Text-fig. 19*b*, *d*. The chief points of interest are the presence of fine hairs on the epidermis of the growth ridges, the broad spur and the strongly developed crests for the depressor muscles. There is a distinct tendency for small incipient crests to develop near the base of the spur. The specimen from near the R. Densu (Text-fig. 19*f*, *g*) has a less robust tergum.

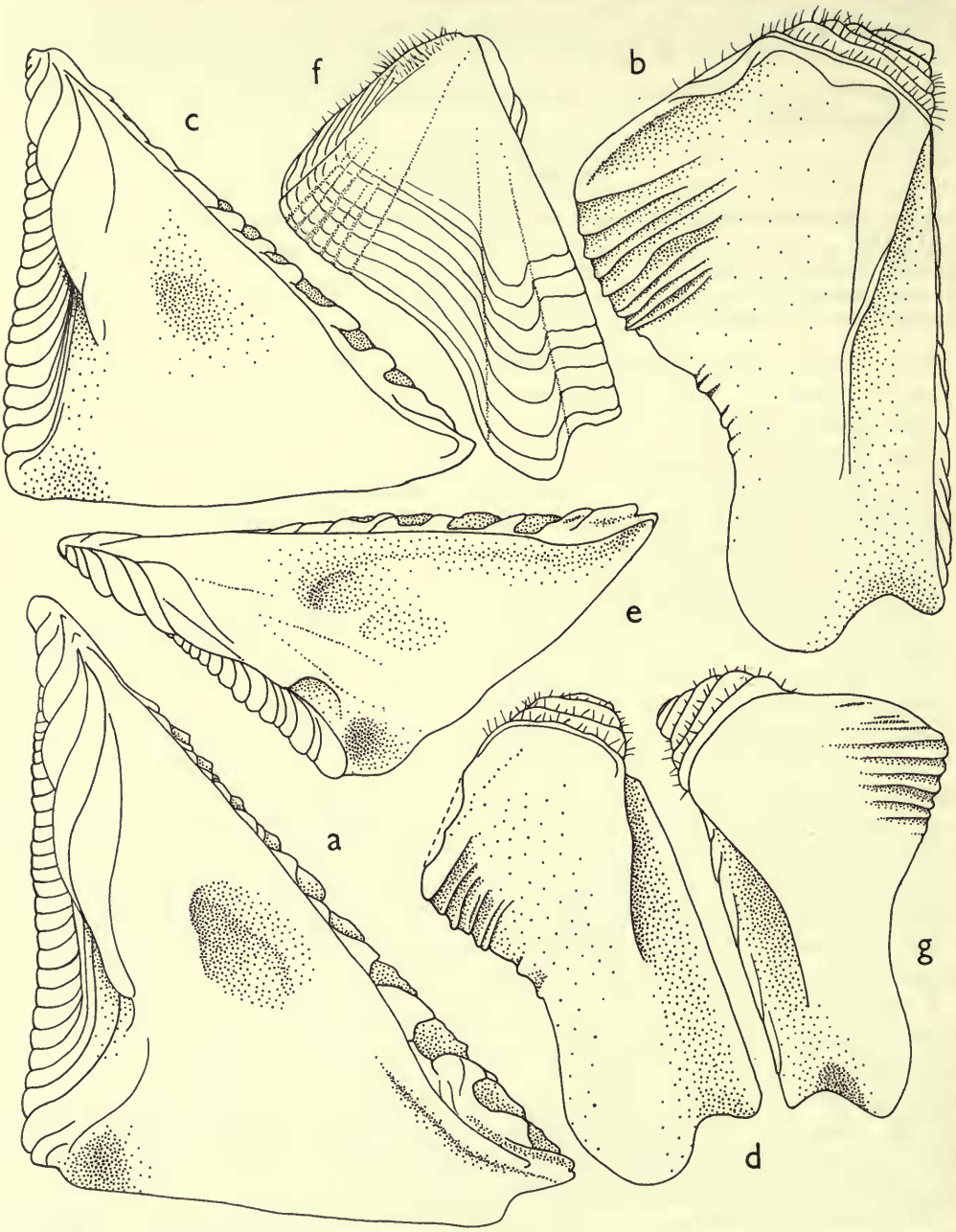

FIG. 19. *Balanus fallax* Broch. *a*, *b*, internal views of scutum and tergum of a specimen from the Osu Fisheries Station, Accra, Ghana ; *c*, *d*, similar views of valves of another specimen from Osu : *e*, *f*, *g*, internal view of scutum and external and internal views of a tergum of a specimen from the R. Densu, Ghana (all ×28).

The spur is much narrower and is pointed at its extremity instead of being rounded as in the heavier Osu specimens. There are no incipient crests in the concave basal margin of the valve. In both these points it agrees with the specimen figured by Utinomi (1959*b*).

Illustrations of the mouth appendages have been given by Broch (1927*a*) and Stubbings (1961*a*, 1963). A few notes on minor variations may be given. The teeth on either side of the labrum (Text-fig. 20*a*) may be directed obliquely away from the mid-line instead of standing perpendicular to the border of the labrum. The palp (Text-fig. 20*b*) agrees with that figured by Stubbings (1961*a*). It is oval or somewhat rectangular, the anterior margin being almost straight, the posterior and distal margins curved. There is a double row of pectinate setae along the anterior margin. The mandible (Text-fig. 20*c*) has been fully described previously. The third and fourth teeth are somewhat bifid and the lower angle has 3 more or less complex teeth, sharply pointed in some specimens but blunt in others. This is probably a matter of wear only. The setae on the lower margin may be described as stout. Whether they should be regarded as " spines " depends on the degree of individual development and a somewhat arbitrary interpretation of the point where a stout seta becomes a spine. The setae on the R. Densu mandible figured were appreciably stouter than those on an Osu specimen. The first maxilla of the Osu specimen (Text-fig. 20*d*) had the small spine lateral to the two large upper spines, as described by Broch. In the R. Densu specimen this spine was absent. The second maxilla is oval and tapers distally to a rounded point. The lower lobe is semicircular. In the R. Densu specimen the second maxilla was much narrower than in the Osu specimens.

The segmentation of the cirri was given by Broch (1927*a*) and in a paratype by Stubbings (1963). The number of segments in cirri I and VI was appreciably lower in the paratype. The segmentation in the cirri of the paratype agreed closely with that of *B. occidentalis* (= *B. fallax*) in Stubbings (1961*a*). Three new counts of segments are now available (Table 6). They agree substantially with earlier counts. It may be noted that in the Accra specimen the number of segments in cirrus VI equalled that given by Broch. In no specimen so far examined has there been 15 segments in the anterior ramus of cirrus I as described by Broch.

TABLE 6

Specimen	I	II	III	IV	V	VI
Accra, 14 m.	12·9	9·7	11·10	18·18	21·22	22·22
R. Densu	13·7	10·10	10·9	18·14*	17·23	17·18
Osu	11·7	9·8	9·8	11*·14*	19·18	20·21
Mean	12·7	9·8	10·8	17·17	19·21	19·20

TABLE 6. Number of segments in the cirri of three specimens of *B. fallax* Broch from three localities in Ghana. * tip of cirrus missing.

The presence of a dorsal process at the base of the penis (Stubbings, 1963) has been confirmed. It is sharply conical, slightly curved and bears a single long seta (Text-fig. 20*f*).

B. fallax is known only from the African coast, from Algiers in the Western

FIG. 20. *Balanus fallax* Broch *a*, labrum ; *b*, palp ; *c*, mandible ; *d*, maxilla I ; *e*, maxilla II ; *f*, base of penis with dorsal spine (*a–c*, *e*, *f*, ×95 ; *d* ×180).

Mediterranean, down the west coast as far as Cape Ledo in Angola. Where more intensive collecting has been done, e.g. Morocco, French Guinea and Angola, there are a number of records, suggesting that the species is common. But there are few specimens in the Ghana collections and none at all from the Gulf of Guinea, suggesting that *B. fallax* is not uniformly distributed over the West African coastline.

Balanus* (*Conopea*) *calceolus Darwin

LOCALITIES: Ghana: Accra, (1) Chorkor, on the horny stem of an alcyonarian, –.3.49 (2 dead and without opercular valves); (2) Chorkor, on a violet and yellow alcyonarian and other alcyonarians, 1.2.50 (11 + 13 dead spec.); (3) Chorkor, on

the same violet and yellow alcyonarian, 12.5.50 (1 spec.); (4) Christiansborg shore, on the same alcyonarian sp., 19.11.49 (4 + 3 juv. spec.); (5) 10 miles off-shore, on a white alcyonarian, 8.5.49 (3 + 1 dead spec.); (6) off Accra, on the violet and yellow alcyonarian, 13.11.51 (1 spec.); (7) 15 m. from Accra beyond Densu 16.5.51 (6 spec.).

Specimens from locality (7) above contained developing eggs of average size 222 × 109 μ.

B. calceolus is known from the Mediterranean and the Atlantic off the Straits of Gibraltar (Darwin, 1854; Caziot, 1921; Utinomi, 1959*b*). On the West coast of Africa it is recorded from Rabat, Morocco (Broch, 1927*a*), Cap Blanc, Mauretania (Broch, 1924*b*), Sierra Leone (Nilsson-Cantell, 1928), Ghana (Gauld, 1957), the Congo and Angola (Nilsson-Cantell, 1938*b*: Stubbings, 1963, 1964*b*). From South Africa Stebbing (1910) records it from Bird Island, Algoa Bay.

B. calceolus has therefore been found at localities spaced along the whole west coast of Africa. There are some considerable gaps between known localities. It is surprising that there are no specimens in the collections of the IFAN, Dakar, in view of the extensive collecting done by that Institution. The absence of records in the Gulf of Guinea may be due to less intensive collecting, or may represent a discontinuity in distribution clearly seen for several other species.

Proceeding eastward it is known from Wasin, E. Africa (Gruvel, 1907*a*), Madras (Darwin, 1854; Nilsson-Cantell, 1938*a*), the E. Indies (Broch, 1922, 1931; Pilsbry, 1916), Japan (Weltner, 1897; Hiro, 1937; Utinomi, 1949, 1958) and from Western Australia (Weltner, 1897).

B. calceolus has therefore an "old world" distribution in warm to tropical seas, extending from the eastern Atlantic eastward to the Indian Ocean and the seas bordering S.E. Asia. It has not been recorded from the remainder of the Pacific and is unknown from the western Atlantic Ocean.

TETRACLITA Schumacher

Very few specimens of *Tetraclita* have been collected in West Africa and the several groups have been assigned to different species by the respective authors. Pilsbry (1916) and Gauld (1957) each record one species from the coast. I disagree with Gauld as to some of his material and consider it belongs to a third species *T. divisa* Nilsson-Cantell (1921). It is questionable whether there are indeed three species in the area but much more material is required from the old collecting sites and elsewhere before an authoritative pronouncement can be made as to how many and which species occur there. The three species in question are discussed below.

Tetraclita divisa Nilsson-Cantell 1921

Tetraclita divisa Nilsson-Cantell, 1921, 362, pl. 3,* fig. 11, text-fig. 83.
Tetraclita divisa: Hiro, 1939, 275, text-fig. 15.

LOCALITY: Ghana: Hospital Reef, Axim, 13.4.49 (2 spec. one without soft parts or opercular valves).

This species is closely related to *T. purpurascens* (Wood) with which it agrees in having a transversely elongated scutum. Whereas *T. purpurascens* has the spur of

the tergum united with the basiscutal angle and the valve elongated, *T. divisa* has a triangular tergum with distinct short and broad spur, separated from the basiscutal angle by about half its width (Text-fig. 21*a*).

Nilsson-Cantell (1921) states that the scutum has no adductor ridge or crests for depressor muscles, but Hiro (1939) finds the adductor ridge may or may not be present and figures (1939, fig. 14*B*) a scutum with a ridge. Zevina & Tarasov (1963) state that the ridge is little developed and do not show it in their figure. The present complete specimen has an adductor ridge (Text-fig. 21*b*). There are no crests for the lateral depressor muscles but a series of about 6 shallow pits for the muscle insertions.

The compartments have well developed radii with horizontal summits. In both specimens the walls are worn, in one so much so that only faint traces of the radii remain. The growth lines on uneroded compartments are fringed with hairs. There are up to six rows of pores in the paries, rather more than described by Hiro. No

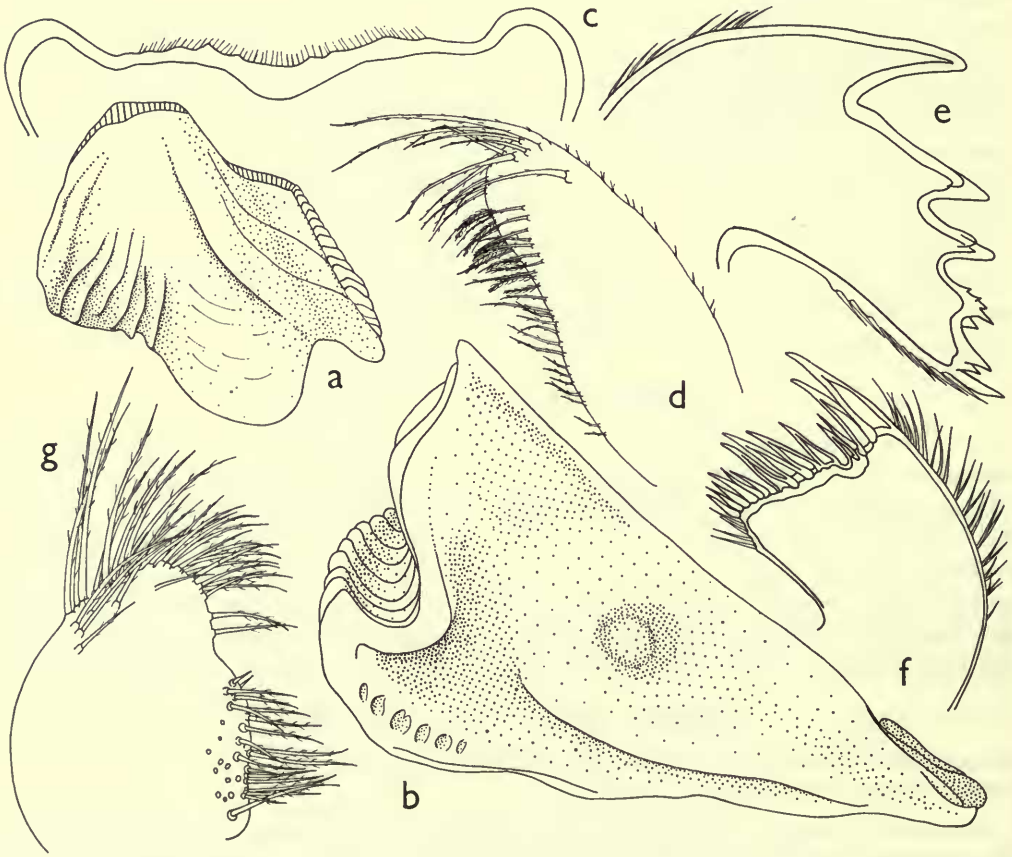

FIG. 21. *Tetraclita divisa* Nilsson-Cantell. *a*, internal view of tergum, *b*, of scutum (both ×40) ; *c*, labrum, *d*, palp, *e*, mandible, *f*, maxilla I, *g*, maxilla II (*c*, *e–g*, ×160 ; *d*, ×120).

trace of basis remains in one specimen. In the other there are fragmentary remains of a rather thin calcareous basis near the walls. The central area of the basis is wanting. Hiro states that the basis in *T. divisa* is calcified peripherally only.

The mouth parts agree substantially with the description of the species by the above authors. The labrum (Text-fig. 21*c*) is even more weakly bowed than in Nilsson-Cantell's figure, being almost straight from side to side with minor irregularities. There are three or four slight prominences, scarcely teeth, on either side of the middle line, as against only two in Hiro's specimen. The palp (Text-fig. 21*d*) is very similar to Nilsson-Cantell's figure even to the rather brushlike plumose setae on the anterior edge. The mandible (Text-fig. 21*e*) has a subsidiary cusp or cusps on all but the first tooth as in Nilsson-Cantell's and Zevina & Tarasov's figures. The fourth tooth has several sharp-pointed cusps as figured by the above authors. Maxilla I (Text-fig. 21*f*) agrees very closely with those figured by Hiro and Nilsson-Cantell. There are minor differences in the arrangement of the central spines relative to the notch in Zevina & Tarasov's figure. Maxilla II (Text-fig. 21*g*) has been figured by Zevina & Tarasov (1963), who show no plumose setae. Plumose setae in the present specimen are restricted to a group at the tip of the appendage and to a second group on the rather protuberant lower part of the anterior border.

The number of segments in the cirri is given in Table 7.

TABLE 7

	I	II	III	IV	V	VI
Ghana	10·5	6·5	5·5	11·11	12·13	14·14
Nilsson-Cantell	8·4	6·5	6·5	12·12	12·12	12·12
Hiro	10·6	8·7	7·6	11·12	14·14	14·14
Zevina and Tarasov	8·5	6·6	6·4	–·8	8·7	9·8
	—	6·5	6·4	7·6	11·9	10·9

TABLE 7. Comparison of number of segments in the cirri of a specimen of *T. divisa* from Ghana with the number given by Nilsson-Cantell (1921), Hiro (1939) and Zevina & Tarasov (1963).

There is close agreement between the number of segments given by the earlier authors and that found in the present specimen. The figures quoted by Zevina & Tarasov (1963) for cirri IV to VI are appreciably lower.

T. divisa was originally described (Nilsson-Cantell, 1921) from Sumatra and Java from material collected by C. W. A. Aurivillius. The only subsequent records are by Hiro (1939) from the east coast of Formosa and by Zevina & Tarasov (1963) from the South China Sea. Its occurrence on the west coast of Africa extends enormously the known distribution of this species and suggests a probable distribution over much of the tropics of the Old World, as it is unlikely this will prove to be an isolated occurrence.

Tetraclita purpurascens Wood

T. purpurascens is included here on the authority of Gauld (1957) who recorded specimens from Victoria, Cameroon and Axim, Ghana. There are no other records of this species from West Africa. It is stated that the specimens corresponded

" exactly " with Darwin's (1954) description. Dr. Gauld informs me (in litt.) that this statement referred specifically to a group of specimens from Victoria and might not be true for the material from Axim. It is possible that this Axim material was originally part of that here described as *T. divisa* Nilsson-Cantell. Unfortunately the Victoria material is no longer available for re-examination.

Tetraclita squamosa squamosa (Bruguière)

Tetraclita squamosa squamosa: Pilsbry, 1916, 251.

Pilsbry (1916, 252) cited two groups of specimens from " West Africa " and " Cape Palmas " (Liberia) which he assigned to the typical subspecies of *T. squamosa* at the same time noting certain differences. It has not been recorded subsequently from West Africa.

PYRGOMA Leach 1817

Pyrgoma anglicum G. B. Sowerby

Localities: Ghana: (1–5) Accra: (1) Sta. 45, 35 m., on dead coral (1 spec.); (2) Sta. 131, 37 m., attached on or near base of the living solitary coral *Balanophyllia formosa* Gravier, 2.5.51 (5 + 1 dead spec.); (3) Sta. 133, 51 m., on a single dead solitary coral (6 dead spec., also remains of the bases of 12 others); (4) no locality, on *Oculina* (*Schizoculina*) *fissipora* Milne-Edwards & Haine received from Dr. D. T. Gauld, University of Ghana (4 dead spec.); (5) on *Caryophyllia* sp. –.2.55, coll. J. B. Buchanan (7 spec.); (6) Axim. " from coral *Astrangia* sp. " –.6.55, coll. J. B. Buchanan (3 spec. without basis or soft parts).

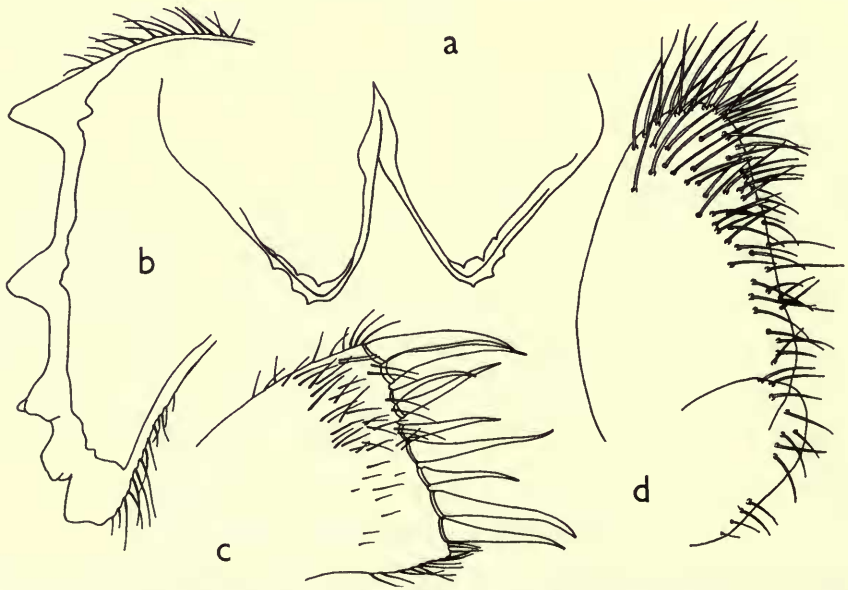

Fig. 22. *Pyrgoma anglicum* Sowerby from Accra. *a*, labrum (×83), *b*, mandible, *c*, maxilla I, *d*, maxilla II (all ×135).

Nigeria: Bonny River Estuary, off Bonny, from a coral dredged in shallow water, 28.1.58 (21 + 3 dead spec.) (H.G.S.).

Dr. Buchanan states (in litt.) that he collected *Pyrgoma* in 1954 from 20 m. off Takoradi, Ghana on *Oculina* sp. and in 1955 from the shore at Dixcove, Ghana on *Porites* sp. and *Siderastrea radians*.

Illustrations of some of the appendages have been given by Broch (1927*a*). The labrum is of the high conical form described by Broch but has three distinct teeth, not one, on either side (Text-fig. 22*a*), thus agreeing with Darwin's description of the labrum of this species. The outermost of the three labral teeth is smaller than the other two. The palp is oval and of the typical form. The mandible (Text-fig. 22*b*) has a rather straight edge, the teeth being rather broad and blunt. The third tooth is slightly bifid. In Broch's specimen the second tooth was slightly bifid. The lower angle is composed of two blunt rounded teeth. There are very few hairs on the surface of the appendage. The first maxilla (Text-fig. 22*c*) agrees closely with that figured by Broch. The edge is straight and without a notch. The large upper spine is followed by eight others of which the first, fifth and last two are rather larger than the others. The surfaces of the appendage are hairy. The second maxilla (Text-fig. 22*d*) is narrowly oval with a small oval lower lobe. It is densely setose along the inner margin and apically. The segmentation of the cirri is shown in Table 8, agreeing reasonably well with that given by Broch (1927*a*):

TABLE 8

	I	II	III	IV	V	VI
Accra	16·9	7·9	8·9	15·16	18·18	19·19
Broch	17·8	7·9	8·10	17·19	18·22	20·23

TABLE 8. Number of segments in the cirri of a specimen of *P. anglicum* from Accra, compared with Broch's (1927) figures.

The segments of the inner ramus of cirrus I are moderately protuberant, those of the outer ramus scarcely so. Cirrus II is very small. Hooked spines occur on segments 2–6 of the inner ramus of cirrus III. Cirri IV–VI have rather fewer segments than in Broch's specimen. In cirrus IV the first four segments are distinguishable though probably fused. The number of hooked spines on each segment of the inner ramus of cirrus IV, compared with the number given by Broch (1927*a*), is shown in Table 9.

TABLE 9

Segment	1	2	3	4	5	6	7	8	9	10
Accra	1	2	2	2	2	2	2	1+r	1	0
Broch	1	2	2	1	2	2	2	2	1	r

fused segments

r = rudimentary spine

TABLE 9. Number of hooked spines on the lower segments of the inner ramus of cirrus IV in *P. anglicum*.

The penis is long and closely annulated and has a basidorsal point.

The coral host of the Bonny specimens eventually grows over the barnacle and entombs it. From the nodular form of the coral specimen and the fact that several nodules revealed enclosed *Pyrgoma* when broken open it is possible that many *Pyrgoma* are so buried. Scuta and terga are present in many of these buried shells so overgrowth of the coral presumably occurs whilst the barnacle is still alive.

Rees (1962, 1966) has discussed the distribution of *P. anglicum* with particular reference to its coincidence with that of the solitary coral *Caryophyllia smithii* in British waters. Rees also indicates the wider distribution of the species southwards to Spain, the Mediterranean and West Africa. To Rees's references may be added Sicily (Kolosvary, 1951) and the Cape Verde Archipelago (St. Iago and Brava) (Stubbings, 1963). These localities confirm Darwin's (1854) earlier records. Gauld (1957) cites *Astrangia* and *Caryophyllia* as host corals off Accra, Ghana, but these coral identifications need confirmation. Gruvel (1903), not quoted by Rees, reported specimens in the Paris Museum from Algeria on *Coenocyathus anthophyllites* and others from " Travailleur " St. 34 on *Dendrophyllia cornigera*, the same host as recorded by Broch (1927*a*) from the coast of Morocco. The present records from Bonny, E. Nigeria represent the furthest kown southerly limit of the species in the Eastern Atlantic.

The Far Eastern records cited by Rees may be extended by adding Madras (Nilsson-Cantell, 1938*a*) and Seto, Japan (Hiro, 1937). Hiro (1935) also apparently accepts Broch's (1931) record of " *Pyrgoma* sp. aff. *anglicum* " from Sagami Bay, Japan as a true *P. anglicum*.

CHELONIBIA Leach 1817

Four species of *Chelonibia* have been recorded from West Africa.

Chelonibia testudinaria (Linnaeus)

Localities : Senegal : from scutes of a turtle, coll. Captain Moloney, B.M. 85.5 (5 large and 2 very small spec.).

Ghana, Accra, 8, pres. Dr. D. T. Gauld (no further data).

The Ghanaian specimens range in size up to 30 mm. carino-rostral diameter. All the shells are disarticulated and the soft parts wanting. The " teeth " on the radii are poorly developed or wanting in these small specimens.

The species is found in Ghana on turtles coming ashore on the sandy beaches and killed by the villagers, but few specimens seem to have been collected. It has been recorded previously from " equatorial Africa " (Gruvel, 1905), Cameroons (Nilsson-Cantell, 1921), Ghana (Gauld, 1957) and Senegal (Stubbings, 1965). It has not been recorded from the more temperate waters of north-west Africa. A number of records for the Mediterranean including the Adriatic are summarized by Kolosvary (1943*a*, 1951). Barnard (1924) records it from Table Bay, South Africa.

Further afield *C. testudinaria* is generally distributed throughout the tropical and warmer temperate seas.

Chelonibia caretta (Spengler)

Records of this species on the West African coast are few and widespread. Darwin (1854) recorded it from the " West Coast of Africa " without further indication of locality. Broch (1924*b*) described it from the Baie du Levrier, Mauretania and in the same year Barnard (1924) from Table Bay, South Africa. Pilsbry (1916) also mentions specimens from the Cape of Good Hope. There appears to be no other record from the west coast of Africa. It is not represented in any of the recent expedition collections. Neither is it present in the collections of the Institut Français d'Afrique Noire. We may conclude, therefore, that *C. caretta* is rare on the west coast of Africa.

Chelonibia manati Gruvel

Chelonibia manati Gruvel, 1903, 116, pl. 2, figs. 14, 17, 18; pl. 4, figs. 15, 16.
Chelonibia manati: Stubbings, 1965, 894, text-figs. 5, 6.

Typical *C. manati* had not been reported since the original description by Gruvel based on material brought from the Congo by Dybowski in 1896 until redescribed by the present author from Senegalese material (Stubbings, 1965). Pilsbry (1916) erected two subspecies *lobatibasis* and *crenatibasis* for material that he assigned only tentatively to *C. manati*. Insofar as could be determined these variant specimens probably came from turtles. The greater resistance to penetration of the turtle shell as compared to the skin of the manatee would account for the relatively intact basal margin of the barnacle shell compartments. This has already been shown to happen on the manatee when adjacent individuals overlap (Stubbings, 1965). It is possible, therefore, that *C. manati* occurs on turtles as well as on the type-host but specimens would then be atypical in having a relatively intact basal margin to the compartments. On the other hand a specimen growing by chance on a soft area of the turtle shell or skin would develop branching parietal ribs approximating to the normal type. This is probably what happened in the case of the incompletely known *C. ramosa* described by Korschelt (1933), which may well be a growth form of *C. manati*.

Distribution : embedded in the skin of the manatee *Trichechus senegalensis* in West African estuaries. It may occur also on turtles in W. African waters and if so, owing to the possibility of distribution by currents and wind, it is liable to occur rarely over a much wider range.

Chelonibia patula (Ranzani)

Localities: Senegal, off Gorée, 99 m. on anchor, coll. Capt. Moloney, B.M. 85.5 (2 shells without soft parts).

Gambia: (1) off Langiang Point on *Callinectes ? marginatus* with *B. venustus*, 10.6.51, coll. M. H. Routh, B.M. 1952.10.2.8 (3 large and 14 smaller spec.); (2) River Gambia, coll. Capt. Moloney, B.M. 01.4 (3 dry shells); (3) off Gunjur, with *B. t. tintinnabulum* from hull of shark-fishing boat, 3.3.52 coll. M. H. Routh, B.M. 1952.10.2.3 (2 spec).

Sierra Leone: (1) 30 m., trawl, from carapace of *Neptunus validus*, 20.9.54, coll. A. R. Longhurst, B.M. 1957.6.3.6 (3 + 7 juv. spec.); (2) 30 m., trawl, from carapace of *Neptunus validus*, 28.9.54, coll. A. R. Longhurst, B.M. 1956.1.7.12 (4 + 3 attached juv. spec.).

Ghana: off Accra: (1) 14 m., with *B. venustus* on shells, 27.4.51 (9 + 8 juv. spec.); (2) 14 m., with *B. venustus* on *Cymbium* shell occupied by a Pagurid, 30.4.51 (3 + 10 juv. spec.); (3) 15 m., on empty *Cymbium* shell, n.d., (1 spec.); (4) on carapace of *Calappa rubroguttata* Herklots, 9.4.51 (2 spec.); (5) 10 m., with *B. venustus* on *Cymbium* fragment, 9.1.52 (2 + 10 juv. spec.); (6) off Chorkor, Accra, 13 m., on *C. rubroguttata*, n.d., (8 + 4 juv. spec.); (7) trawl, on *Cymbium porcinum* with *B. venustus*, coll. E. Salzen, B.M. 1957.6.3.1 (9 + 21 juv. spec.).

Nigeria: (1) Lagos, attached to cork thrown up on beach (dead shells only) (H.G.S.); (2) Bonny River, E. Nigeria, from No. 2 fairway buoy about 3 ft. below water line (13 spec.).

The scutum and tergum have been inadequately figured previously and those of a specimen from Bonny are shown in Text-fig. 23. The scutum (Text-fig. 23*b*, *d*) shows no trace of longitudinal furrows but growth lines are deeply sculptured. On the tergum (Text-fig. 23*a*, *c*) the successive growth increments are demarcated by furrows, the incremental areas being convex in section and ornamented by fine grooves. The mouthparts, likewise inadequately figured, agree with Darwin's description. The

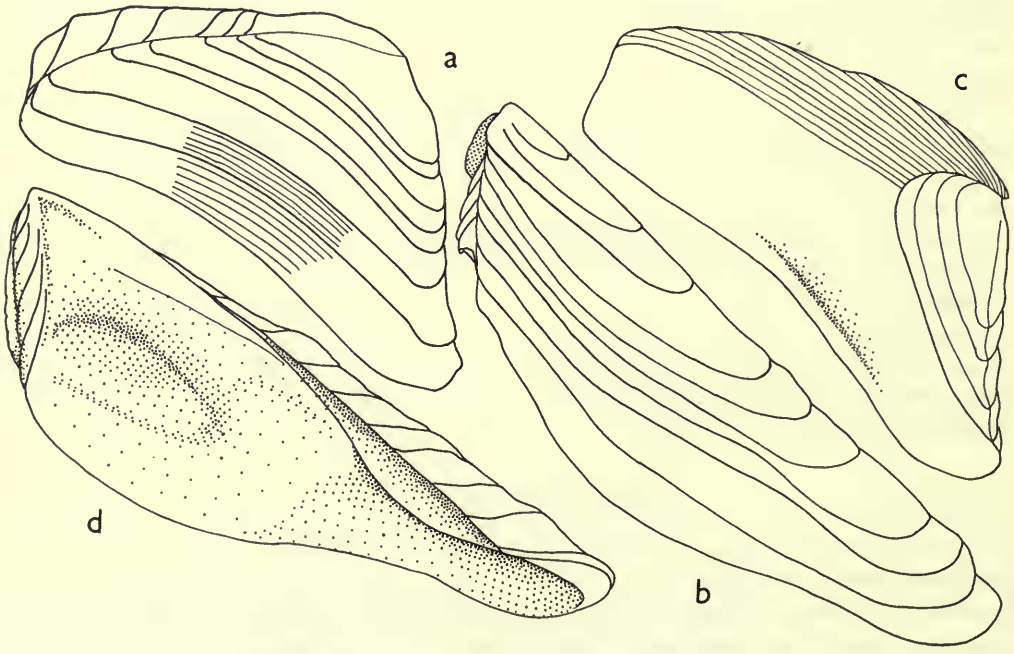

FIG. 23. *Chelonibia patula* (Ranzani). Scuta and terga of a specimen from the Bonny River, Nigeria: *a*, *b*, external surface of left tergum and scutum, *c*, *d*, internal surface of right tergum and scutum. (all ×14).

labrum (Text-fig. 24*a*) is deeply notched, and armed on each side with 20–24 prominent teeth diminishing in size from the midline outwards. The palp (Text-fig. 24*b*) is club-shaped slightly concave on the anterior margin and only sparsely clothed with setae at the distal extremity. The mandibles are 5-toothed. On the specimen dissected (Text-fig. 24*c*) only the 2nd and 3rd teeth bear subsidiary points and not the second and fifth as described by Darwin. The lower angle bears short stout spinules. The first maxilla (Text-fig. 24*d*) is not notched. There are two stout upper spines and a row of lesser spines on the edge. The lower angle is setose. The second maxilla (Text-fig. 24*e*) bears a small oval secondary lobe.

Cirri I and II are short and stout with densely setose and moderately protuberant segments. Cirrus III is intermediate between the first two and cirri IV–VI which

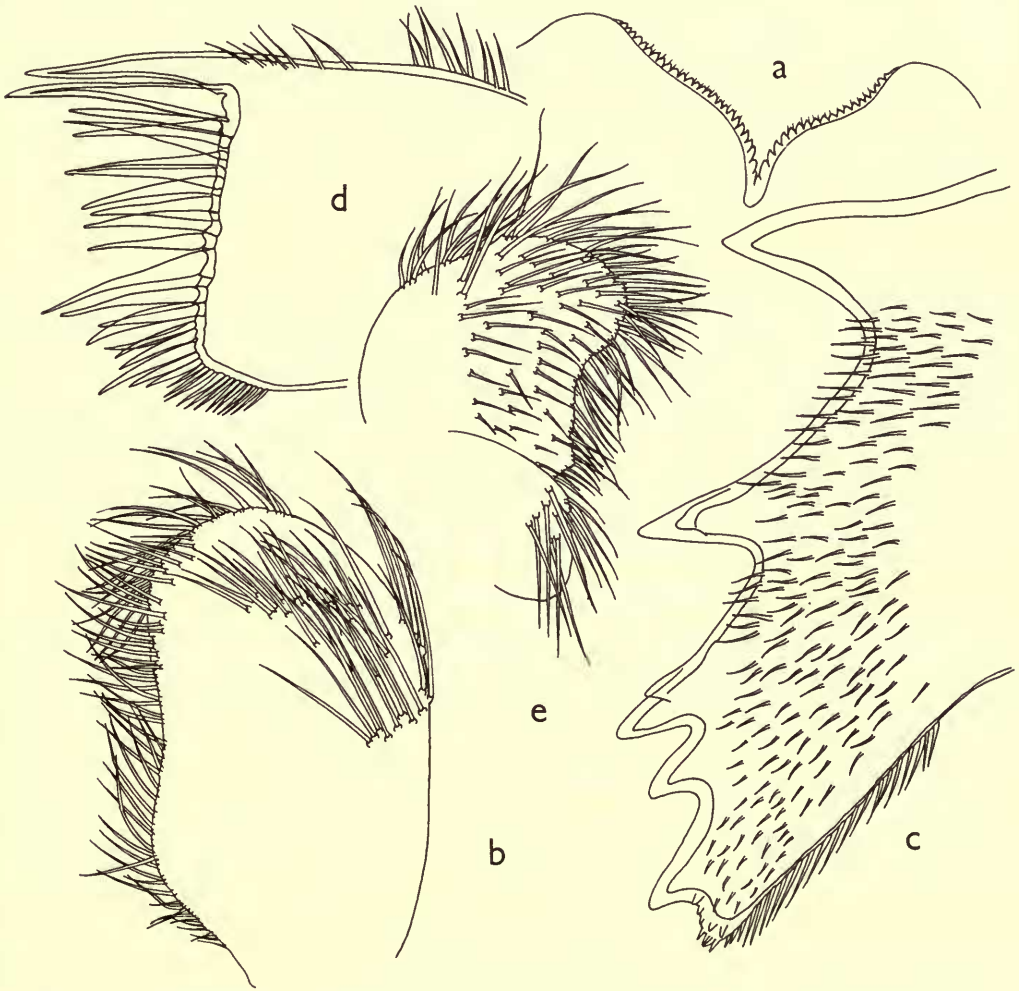

FIG. 24. *Chelonibia patula* (Ranzani) : mouth parts of the same specimen as in Fig. 23 *a*, labrum, *b*, palp (both ×50) ; *c*, mandible ; *d*, maxilla I (both ×80) ; *e*, maxilla II (×50).

are similar. The inward direction of the setae on cirri I–III which lie more on the inner face of the segments and not on their anterior faces is marked. The segmentation of the cirri in the specimen dissected is as follows :

TABLE 10

I	II	III	IV	V	VI
16·15	14·14	20·21	32·33	41·35	41·39

TABLE 10. Segmentation of the cirri of a specimen of *C. patula* from the Bonny River, E. Nigeria.

C. patula is known from French Guinea, Sierra Leone, Ivory Coast, Ghana and Nigeria and presumably therefore occurs throughout subtropical and tropical West Africa. It is commonly found on the larger crabs and Gastropoda, notably old *Cymbium* shells occupied by Pagurids (Gauld, 1957 ; personal observations) and on artifacts such as navigation buoys. It is a sub-littoral shallow-water species, only occasionally cast ashore on floating or sunken debris.

Beyond the west coast of Africa it is known from the Mediterranean and from most tropical and subtropical regions.

Coronula complanata (Mörch)

The authority for including *C. complanata* in the West African fauna would appear to be Pilsbry (1916) who records the presence of some old material labelled West African without name of collector in the U.S. National Museum. But from the tone of the passage the author did not place much reliance on this evidence of provenance. There are no other records for the coast, the nearest being from Table Bay and Simonstown (Barnard, 1924) and the Cape of Good Hope (Nilsson-Cantell, 1932*a*). In the absence of commercial whaling off the coast of West Africa and the very slender chance of a stranded whale with this barnacle being recorded on that coast it is unlikely that confirmatory material will ever be forthcoming.

Platylepas hexastylos (O. Fabr.)

P. hexastylos is not represented in the Ghanaian and Nigerian collections. Records from West Africa are surprisingly few, doubtless due to the unpredictable occurrence and chance collection of the host animals. Specimens are recorded from the Gambia (Darwin, 1854), Mauretania and Morocco (Broch, 1924*b*, 1927 respectively), Sierra Leone and Senegal (Stubbings, 1965). There are more records from the Mediterranean, from turtle hosts.

Elsewhere, *P. hexastylos* is known from the tropical and sub-tropical west Atlantic, from S.E. Asia and from Eastern Australia.

Stomatolepas elegans (O. G. Costa)

Stomatolepas elegans: Pilsbry, 1916, 289, pl. 68, figs. 2, 2*a*.
Stomatolepas elegans: Hiro, 1936, 312, text-figs. 1–5.

The West African status of this species is based on a single specimen in the collections of the Institut Français d'Afrique Noire from *Caretta caretta* (Stubbings,

1965) on which host it was associated with *Chelonibia testudinaria* and *Platylepas hexastylos*.

Hiro (1936) considered that there was only one species, *Stomatolepas elegans* (Costa) and that *S. praegustator* Pilsbry (1910) and *S. transversa* Nilsson-Cantell (1930*b*) were synonymous. The scattered localities recorded by these authors indicate that *Stomatolepas* is widespread in tropical and sub-tropical waters. On the basis of known records it is nowhere common, though this may be a result of the inconspicuous character of the species when embedded in the rough skin of turtles.

Xenobalanus globicipitis Steenstrup

X. globicipitis is of world-wide distribution as might be expected of a species associated with Cetacea. Records for West Africa come solely from the collections of the Institut Français d'Afrique Noire and are all from Senegal (Stubbings, 1965). The nearest other records are those made by the Prince of Monaco in the Atlantic off the mouth of the Mediterranean and in the Azores (Gruvel, 1920).

The cetacean hosts of *X. globicipitis* were listed by Nilsson-Cantell (1930*a*). The IFAN specimens were found on *Delphinus delphis*, *Phocoena phocoena* and *Feresa attenuata*, all except the first being new hosts for this barnacle.

ACROTHORACICA

No species of Acrothoracica were known from West Africa prior to 1957. In that year Gauld reported the occurrence of *Kochlorine hamata* in old shells from the Ghana coast. Subsequently, with increased interest in the Cirriped fauna of West Africa, a further three new species have been described and it would seem highly probable that yet others will be found eventually.

CRYPTOPHIALIDAE

CRYPTOPHIALUS Darwin 1854

Cryptophialus coronatus Tomlinson

Cryptophialus coronatus Tomlinson, 1960, 404, figs. 1–3.

This species was found in the shell of *Haliotis tuberculata* L. from Gorée Island, Senegal. It has not yet been recorded from any other locality.

Cryptophialus variabilis Stubbings

Cryptophialus variabilis Stubbings, 1961*b*, 189, fig. 6.

This species was found in molluscan and *Balanus tintinnabulum* shell rubble from the Island of Principe, Gulf of Guinea.

KOCHLORINIDAE

Kochlorine hamata Noll

Localities: Ghana: (1–5) Accra: Sta. 10 (5 spec.); Sta. 81 (5 spec.); Sta. 106 (210 spec.); Sta. 107 (266 and 25 spec.); Sta. unknown (249 spec.); (6) Prince's

Town shore (c. 12 spec.); (7) 2 miles west of River Densu, 7·3 m., in shell encrusted with the Polyzoan *Membranipora arborescens* (Canu & Bassler) (3 spec.).

Gulf of Guinea off Annobon: "Calypso" Sta. 107, 1° 26′ 15″ S. 5° 35′ 40″ E., 60 m. in nodule of shell material, 4.7.56 (2, possibly more spec.).

All the Ghanaian specimens except those from Prince's Town and the R. Densu locality were in shells of *Murex bourgeoisi* Tournouer. The number of specimens infesting a shell may be very high, each of the figures (210), (266) and (249) above representing the total number of *Kochlorine* recovered from two infested Gastropod shells, broken up and digested with acid. There may therefore be appreciably more than 100 specimens of *K. hamata* in an infested *Murex bourgeoisi* shell. Living *Murex*, shells occupied by hermit crabs and empty shells are colonized. *Murex* appears to be infested more readily than other gastropod shells. The Prince's Town specimens were recovered from an unidentified fragment of a large thick-walled gastropod shell, bored also by the mollusc *Lithophaga aristata* (Solander).

LITHOGLYPTIDAE

Kochlorine inermis Stubbings

Kochlorine inermis Stubbings, 1964*b*, 343, fig. 5.

This species was described from a single specimen found in the tergum of a small *B. tintinnabulum* taken at Malembe, Angola. As yet there has been no further record of this species.

Kochlorinopsis discoporellae gen. et sp. n.

Localities: Senegal, coll. I. Marche-Marchad (1) South of Gorée I., 38–42 m. in *Cupuladria canariensis* (Busk), 27.10.53: (2) the same, 40–41 m., in *C. canariensis*, 24.2.53; (3) South of Cape Verde Peninsula, 95 m., in *C. canariensis* and *Discoporella umbellata* (Defrance), 18.2.54; (4) Baie de Seminoles, Gorée, 38 m., in *Cupuladria multispinata* (Canu & Bassler) and *D. umbellata*, 8.12.53; (5) SW of Madeleines Light, 48 m., in *D. umbellata*, 15.9.53; (6) " Alignment Gorée-Cap Manuel, lantern de Madeleine, 35–42 m., in *D. umbellata*, 19.10.56; (7) 20–25 miles off Saloum, 35–37 m., in *D. umbellata*, 8.3.55.

Guinea: Parages des Fles de Los, Conakry, 19 m., in *C. multispinata* and *Cupuladria owenii* (Gray), 21.1.53, coll. I. Marche-Marchad; (2) " Calypso " Gulf of Guinea Cruise, Sta. 7, 9° 40′ N., 13° 53′ W., 18 m., in *C. owenii*; (3) Atlantide Sta. 146, 9° 27′ N., 14° 48′ W., 51 m., in *C. canariensis* and *D. umbellata*.

Ivory Coast: " Calypso " Gulf of Guinea Cruise Sta. 17, 5° N., 5° 28′ 30″ W., 27 m., in *C. canariensis* and *D. umbellata*.

Ghana: Accra (1) Sta. 132, 44 m., in *D. umbellata*, 2.5.51; (2) Sta. 133, 51 m. in *D. umbellata*, 2.5.51 (9 spec.).

Gabon: (1) " Calypso " Gulf of Guinea Cruise Sta. 45, 0° 25′ N., 9° E., 73 m., in *Discoporella reussiana* (Manzoni); (2) " Discovery " Sta. 279 off Cape Lopez, 58–67 m., in *C. canariensis*, 10.7.27.

The original specimens from which this new species is described, and the type selected, came from Mr. Bassindale's Sta. 133 off Accra, Ghana, (Bassindale, 1961, text-fig. 2). This is therefore the type locality. Miss P. L. Cook in her study of

West African Cupuladriid Polyzoa (1965*a*) found Acrothoracica in a number of species from several localities. Through her courtesy in passing these to me for study I am able to give the other records listed above. I have to thank Dr. Torben Wolff of the University Zoological Museum, Copenhagen for the use of material from " Atlantide " Sta. 146 off Guinea, which also was recognised by Miss Cook in her examination of the " Atlantide " Cupuladriidae.

Diagnosis: Mantle extremely flattened. No flattened attachment " pad " but the mantle adjacent to the dorsal lip of the orifice is thickened somewhat and protuberant. Mantle with longitudinal and transverse muscles. Orifice slit-like with inner lip armed with bifid or more complex spines. Mouth cirri well developed on long two jointed pedicels with rami of five and four segments. Three pairs of terminal cirri. Caudal appendages present, two-segmented.

Types: Holotype BM 1966.12.5.1. paratypes BM 1966.12.5.2–8 from Accra Sta. 133.

The appearance of the orifices of the cavities inhabited by *K. discoporellae* in a zoarium of *D. umbellata* is shown in Pl. 1*a*. The location of the cirripedes within the thickness of the zoarium is revealed by decalcification (Pl. 1*b*).

The mantle is oval, light brown (in spirit) about 3 mm. long by 2 mm. broad and extremely flattened laterally so that the whole animal is somewhat transparent viewed by transmitted light. The orifice is elongated, slit-like and not on a prolongation of the mantle. The margins of the orifice are bordered by setae and short stout"stellate " spines with two or three or more recurved teeth (Text-fig. 25*a*, 26*a*). Towards the ventral side the lips of the orifice are prolonged into short triangular processes. Beyond these the margins carry a row of fine stout spines forming a " comb " collar. The ventral margin of the mantle is crenated. It bears four or five recurved hook-like spines reducing in size posteriorly where several of the typical stellate spines finish the row. In young specimens the antennules can be seen lying close against the dorsal side of the mantle (pl. 1*c*).

The mantle has longitudinal muscle bands running from a little below the orifice toward the opposite end of the mantle parallelling the ventral margin. There are no such muscles over the dorsal half of the mantle which is thin and transparent. The muscles are attached to a thickened band of the mantle delimiting the non-muscular area. The circular muscle system is less developed. Fine muscle bands attached to the thickened attachment process radiate towards the ventral margin of the mantle. In the posterior part of the mantle these muscles run from the thickened band to the ventral margin. Retractor muscles from the orifice run to the body and to the thickened attachment area. These correspond to the retractor corporis and retractor orificii muscles of Utinomi (1950). There is no " retractor *palii rostralis* " (Utinomi 1963). Some of the anatomy as elucidated from a whole mount is shown in Text-fig. 25*b*. There is a single pair of lobe-like processes on the ventral side of the body, probably comparable to the two pairs described by Utinomi (1950) in *Berndtia purpurea*. Mouth cirri, three pairs of terminal cirri and caudal appendages are present. The mouth cirri (Text-fig. 26*e*) have a long two-segmented pedicel, the first segment being greatly elongated. The rami are composed of 5 and 4 segments respectively. A mouth cirrus of another specimen had rami of 7 and 5

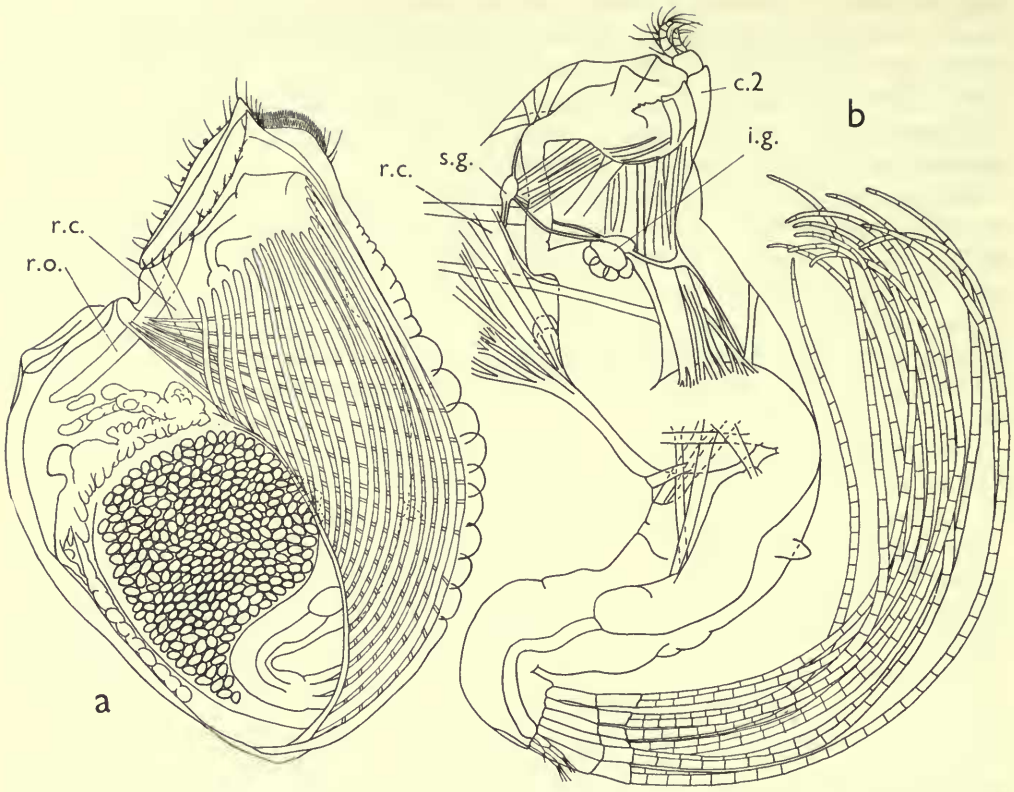

FIG. 25. *Kochlorinopsis discoporellae* gen. et sp. n., *a*, whole animal to show mantle musculature, ovary and egg mass. The broken line within the mantle indicates the ventral surface of the body : the cirri have been omitted (×25) ; *b*, animal with mantle removed (×38). Setae omitted from the cirri. *C.2* mouth cirrus ; *i.g.* infra-oesophageal ganglion ; *r.c.* retractor corporis muscle ; *r.o.* retractor orificii muscle ; *s.g.* supra-oesophageal ganglion.

segments. The terminal cirri are biramous and multi-articulated. The first pair is slightly shorter than the succeeding two pairs. The segments are about twice as long as broad proximally, increasing to about four times as long as broad distally. Each segment bears two pairs of setae anteriorly, the upper pair long and stout, the lower short and fine. Posteriorly each bears a single seta or pair of setae. The caudal appendages are short and two-segmented. The terminal segment bears three short setae.

The labrum is strongly folded so as to embrace laterally the mouth appendages. Its margin is entire and convex and without teeth or hairs. There is a slight suggestion of serration of the margin close to the middle line but there are no teeth. Behind the margin two single lines of long setae run backward parallel to the midline. In a flattened preparation these point towards the middle line but in life they stand more or less upright. There are a few shorter hairs scattered between these lines.

The palps (Text-fig. 26*b*) are very small and conical with a long base of attachment.

They bear a few setae on the outer margin and three or four longer ones at the tip. The mandible (Text-fig. 26*c*) has three simple teeth and a dentate lower angle with about 6 fine teeth. The lower margin has a short row of fine setae.

The maxilla (Text-fig. 26*d*) has a long straight upper margin and short lower margin, the articulation thus being rather long. The anterior margin has a very marked broad notch bearing two stout but short spines. There are two large upper spines strongly curved towards the notch. At their base laterally is a short stout spine similarly curved. The lower and larger part of the anterior edge bears two pairs of short stout spines separated by a gap with short setae. The lower angle is receding and carries a few short spines grading into a few slender setae on the lower margin. There are a few small spines on the surface of the appendages.

The second maxilla is typical of the Acrothoracica, tapering to a point distally and with a very thick outer margin so that the appendage is wedge-shape. The inner margin is concave distally and convex proximally giving the impression of a greatly enlarged lower lobe here. The apical portion is thickly covered with long setae.

Dwarf Male : dwarf males are found in association with most females. One is

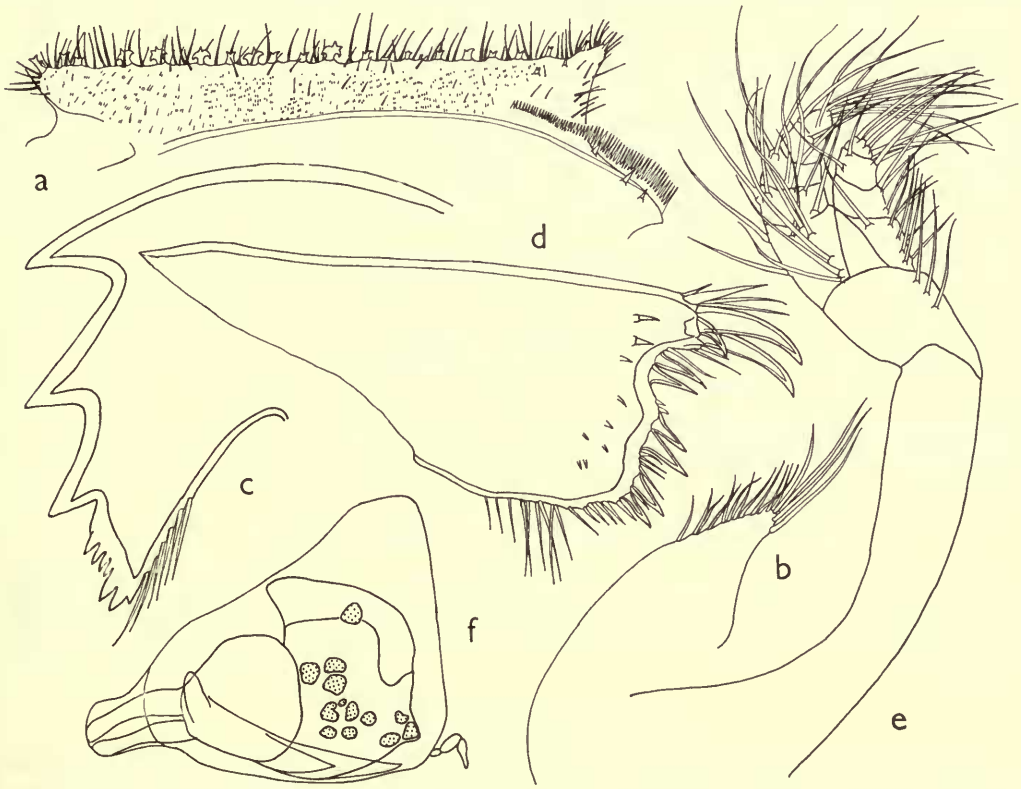

Fig. 26. *Kochlorinopsis discoporellae* gen. et. sp. n., *a*, mantle edge showing spines and comb collar (×93) ; *b*, palp (×170) ; *c*, mandible ; *d*, maxilla I (both ×380) ; *e*, mouth cirrus (×170) ; *f*, dwarf male (×160).

shown in Text-fig. 26*f*. It is triangular in side view, flattened and reminiscent in form of that of *K. hamata* Noll though not so markedly concave on the side opposite the antennae. One two-jointed antenna was present on the specimen. The posterior end is slightly drawn out into a blunt process, presumably the penis sheath. This end of the animal is deeply staining and appears to contain a muscular tube, the penis in the contracted state. The internal anatomy is only partially visible. The penis appears to swell out and fill the posterior part of the organism. There appears to be a wide tubular structure lying near the surface close to the margin between penis and antenna, probably the vesicula seminalis. A number of deeply staining irregular or rounded bodies in the opposite half of the animal are presumably lobes of the testis.

The dimensions of this specimen were length 0·33 mm. depth 0·20 mm.

In having well-developed mouth cirri, an attachment disc, short labrum and no lateral bar this species resembles both *Lithoglyptes* and *Kochlorine*. *Lithoglyptes* has four pairs of terminal cirri as against three pairs in *Kochlorine*. On this basis the present species should be referred to *Kochlorine*. The absence of the long retractor muscle along the rostral side of the mantle (" retractor pallii rostralis " of Utinomi, 1963) is against this. The genera *Kochlorine* and *Balanodytes* both have this prominent paired muscle band which Utinomi (1963) and Tomlinson (1963) consider as diagnostic of the family Kochlorinidae. Utinomi considers (1963 : 70) that the number of pairs of cirri and the presence or absence of caudal appendages should be regarded as of generic value only and that the musculature is a better criterion of family relationships. On this basis *K. discoporellae* should be assigned to the Lithoglyptidae (Aurivillius, 1894 ; emend. Tomlinson & Newman, 1960) as " retractor corporis " and " retractor orificii " muscles are present. This procedure demands, however, a further amendment of the family diagnosis to include forms with only three pairs of terminal cirri. Furthermore inclusion of this species in *Lithoglyptes* would entail redefining this genus. Hence it is proposed to erect a new genus within the Lithoglyptidae to contain species with only three pairs of terminal cirri. The species is accordingly named *Kochlorinopsis discoporellae* g. et sp. n., recording its cirral affinity with *Kochlorine* and its association with the Polyzoan *Discoporella umbellata*. The diagnoses of family and genus follow :

Family **LITHOGLYPTIDAE** emend.

Mouth cirri well-developed, the pedical two-jointed. Three to five pairs of terminal cirri, if less than five pairs, then caudal appendages present. No gut teeth or gizzard. No lateral bar. Attachment disc present, retractor orificii and r. corporis muscles present.

Genus ***KOCHLORINOPSIS*** nov.

Lithoglyptidae with three pairs of terminal cirri : caudal appendages present, two-jointed : mouth cirri with number of segments in rami varying from five and four to seven and five.

Type, *K. discoporellae* nov.

3. THE WEST AFRICAN CIRRIPED FAUNA

From geographical plots of the distribution of the various species it is possible to distinguish several groups of species in which the individual members have approximately the same limited geographical range. Other species are apparently cosmopolitan. A considerable number are still insufficiently known for their geographical range to be determined.

The following groups of species can be distinguished :

(1) *Northern species* (Text-fig. 27A)

Species with a wide range in latitude extending from high latitudes in the northern hemisphere into sub-tropical and tropical waters. Two species only have this distribution, *Scalpellum scalpellum* (L.) and *Chthamalus stellatus stellatus* (Poli). *S. scalpellum* ranges south to the Congo and Angola. The main distribution of *C. stellatus* appears to end in the latitude of Dakar (Cape Verde) though small numbers have been recorded from as far south as Angola. It is probable, however, that the records of this species from south of the Bight of Biafra, as well as those from the Eastern Mediterranean are erroneous and due to misidentifications.

(2) *Western English Channel to the Gulf of Guinea* (Text-fig. 27B–D)

In this series are included species with a northern limit of distribution in the south-west English Channel, on the Atlantic coast of Europe or in the Western Mediterranean and which extend southwards through the Gulf of Guinea. In this category, in order of diminishing northward distribution fall :

Pyrgoma anglicum Sowerby
Balanus perforatus Bruguière
B. spongicola Brown
B. tulipiformis Darwin
B. fallax Broch

Much of the geographical range of *P. anglicum* coincides with that of *B. perforatus*, the major differences being the extension of the range of *B. perforatus* into the Eastern Mediterranean and south of the Gulf of Guinea and the presence of *P. anglicum* in the Cape Verde Archipelago where *B. perforatus* is hitherto unknown.

(3) *South-west Europe to Cape Verde* (Text-figs. 27D, 28A)

Species distributed from the Atlantic coast of Europe or the Western Mediterranean to the region of Cape Verde only.

Mitella pollicipes (Gmelin)
Heteralepas cornuta (Darwin)
Paralepas minuta (Philippi)

H. cornuta is still further restricted in distribution in that it is known only from north-west Africa, from Morocco to the Cape Verde Islands.

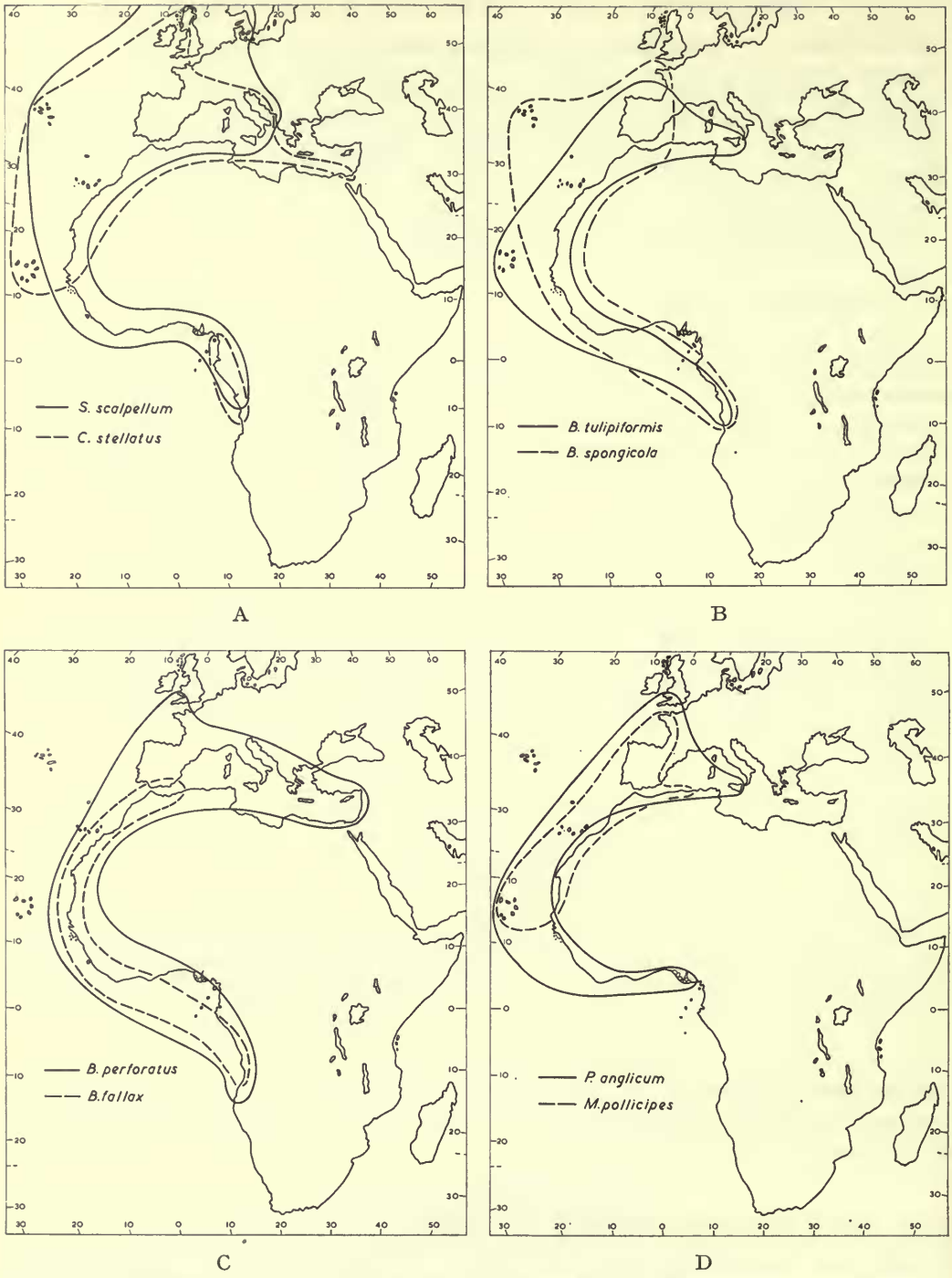

FIG. 27. Distribution of some West African barnacles. A. The northern components *Sc. scalpellum* (L.) and *C. stellatus* (Poli). The far northern distribution of *Sc. scalpellum* is omitted. The eastern Mediterranean distribution and that south of the Gulf of Guinea for *C. stellatus* may be erroneous due to mis-identifications. B, C, D, South-west Europe, Western Mediterranean, North-west and West African species. *B. perforatus* extends also to the Eastern Mediterranean.

(4) *Endemic West African species* (Text-fig. 28B, C)

There are only five species that can be regarded as possibly endemic in tropical West Africa :

Smilium renei (Gmelin)
Ibla atlantica sp. n,
Chelonibia manati Gruvel
Balanus pallidus Darwin
Chthamalus aestuarii Stubbings

S. renei, *C. manati* and *B. pallidus* extend northwards to Dakar ; *C. aestuarii* is not known as yet north of Sierra Leone and *Ibla atlantica* only from off Sierra Leone. The known southern limit of all except the *Ibla* is northern Angola. *B. pallidus* is an abundant intertidal species in West Africa. There are a few records from other parts of the old world (" P " in Text-fig. 28*c*), but these could be instances of ship-borne introductions or even misidentifications. Darwin (1854) mentioned seeing specimens of *B. pallidus* " from the West Indies ". Specimens from Cananéia, S. Paulo, Brasil received through the kindness of Dr. V. Zullo are of this species, which may, therefore, occur naturally on both sides of the tropical Atlantic.

It is possible that *B. tintinnabulum zebra* is a West African variety but here again it may well be that the pattern of its natural distribution, which is very imperfectly known, is blurred by records of ship-borne specimens.

(5) *South African species* (Text-fig. 28D)

Only two species can be considered as South African with an extended distribution northward in the Atlantic namely *Chthamalus dentatus* and *Balanus maxillaris* but the evidence is not clear cut. *C. dentatus* is a common species at the Cape and on exposed coasts in West Africa as far as Dakar. It is recorded from several widely spread Indian Ocean localities so should perhaps be regarded as an Indian Ocean form that has penetrated to the Atlantic. Until records for the Indian Ocean are much more numerous, however, its true status is debatable.

It is questionable whether *B. maxillaris* is native to West Africa. It is well-known at the Cape but the sole record north of Angola is for Port Etienne, Mauretania, which suggests that this may be a chance introduction. Further records from Gough Island and between South America and the Falkland Islands in the South Atlantic (Nilsson-Cantell, 1939*a*) suggest that *B. maxillaris* may be really a southern temperate species widespread in those latitudes as suggested by Kolosvary (1943*b*).

(6) *Circumtropical species*

Several species are known from the tropics of both the old and new world :

Trilasmis (*Poecilasma*) *kaempferi* (Darwin)
Octolasmis lowei (Darwin)
B. amphitrite amphitrite Darwin
B. calceolus Darwin (old world tropics only)
B. tintinnabulum tintinnabulum (L.)
B. trigonus Darwin
B. venustus Darwin

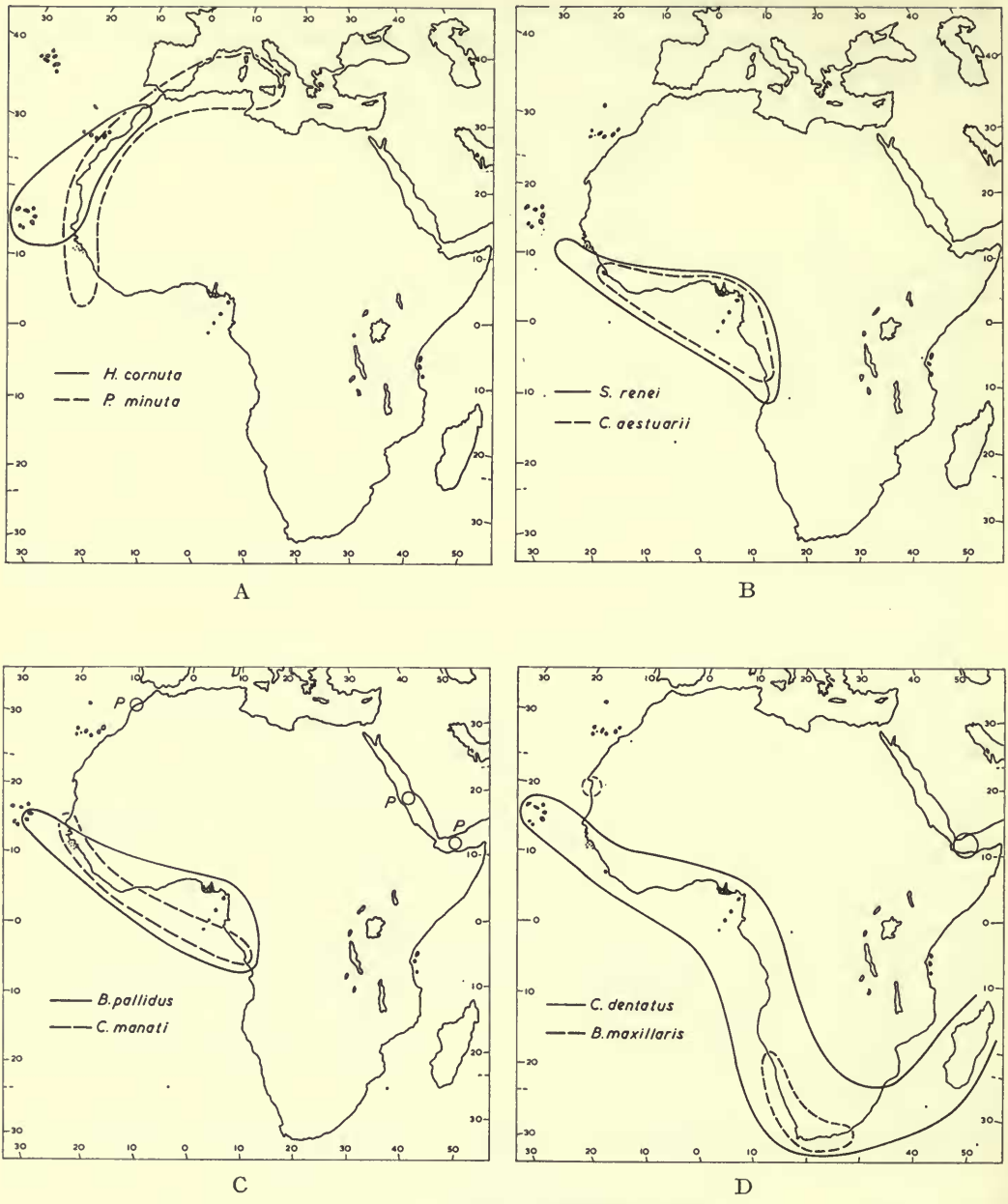

FIG. 28. Distributions of African species: A, temperate-subtropical Western Mediterranean and N.W. African: B, C, West African–Gulf of Guinea tropical species. Three isolated reported occurrences of *B. pallidus* in North-west Africa, the Red Sea and Gulf of Aden are ringed and marked with a "P": D, the temperate South-African element —*C. dentatus* Krauss extending throughout tropical West Africa and the southern *B. maxillaris* with a single record from the Cap Blanc region.

The inclusion of *O. lowei* in this group is dependent upon the interpretation of the synonymy of this species. If the Western Atlantic and Pacific specimens are conspecific with those of the Eastern Atlantic then the species is certainly circumtropical.

B. venustus Darwin is present on the whole West and South African coast from Port Etienne, Mauritania to Natal, with an outlying northern record from Cadiz Bay, southern Spain. It is particularly abundant off Ghana and this might well be the centre of distribution of the species. The picture is complicated, however, by an isolated series of records in the Bay of Bengal from Ceylon, to Akyab in Burma. There are no East African or Arabian Sea records linking these two areas.

(7) *Deepwater elements*

The few species so far collected from beyond the continental shelf indicate the presence of a deep-water barnacle fauna here as elsewhere. The following five species are the only ones so far recorded :

Smilium longirostrum (Gruvel)
Scalpellum imperfectum Pilsbry
S. trapezoideum Hoek
S. velutinum Hoek
Verruca striata Gruvel

By comparison with the known fauna of the Azores region it may be expected that many others await discovery.

(8) *Introduced species*

Several species recorded sporadically are well-known to have spread from their original homes by the unwitting agency of man. Others may have spread in the same way but have not been detected. The following species, found sporadically in West Africa, may have this doubtful status.

Octolasmis hoeki (Stebbing)
Chthamalus fragilis Darwin
C. stellatus bisinuatus Pilsbry
Balanus eburneus Gould
B. venustus niveus Darwin
B. nigrescens Lamarck
B. tintinnabulum concinnus Darwin

The first five have representatives in North and Central American waters, the two Balani most probably having been spread from there by man. *B. nigrescens* was probably introduced from the western Pacific. *B. tintinnabulum* may also have been introduced on ships from that ocean. Two further varieties, *B. t. azoricus* Pilsbry and *B. t. spinosus* (Gmelin) may also be incomers, the first from the Azores presumably being carried by ships. *B. t. spinosus*, as suggested elsewhere (Stubbings, 1961*b*) is perhaps another island race that occasionally reaches the African mainland.

There is left a number of species recorded from West Africa for the distribution of which there is wholly inadequate knowledge. The very few records from African waters (in many instances only a single record) are inadequate to establish these as

W. African species. The following all require confirmation from new finds :

Trilasmis (*Poecilasma*) *crassum* (J. E. Gray)
Octolasmis tridens (Aurivillius)
Chthamalus stellatus bisinuatus Pilsbry
Pachylasma gigantea (Philippi)
Balanus tintinnabulum maroccana Broch
B. amphitrite albicostatus Pilsbry
Tetraclita divisa Nilsson-Cantell
T. purpurascens Wood
T. squamosa squamosa (Brug.)

In considering the above groupings of species the pelagic species of *Lepas* and *Conchoderma* and those species found on turtles or cetaceans have been excluded. The wide-ranging habits of the host animals or the drift of floating debris used as a support render specific zoogeography of these barnacles valueless. The one exception has been *Chelonibia manati* ; the estuarine habitat and sluggish habits of the sirenian preclude long migrations.

After removal of these nine species, the deep water species, the introduced species and those with imperfectly known distribution, some 24 species are left for which the zoogeographical information is more or less adequate. Three of these species, *T. kaempferi*, *B. t. tintinnabulum* and *B. trigonus* are circumtropical. Two, *B. v. venustus* and *B. calceolus* and possibly a third *B. a. amphitrite* are old world tropical species but have a restricted Atlantic distribution. They have been placed in Table II with species of similar distribution. Where a species is apparently at the limit

TABLE II

Species	S.W. Europe	W. Med.	N.W. Afr.	W. Afr.	S.W. Afr.	S. Afr.
Sc. scalpellum	+	+	+	+	+	—
B. perforatus	+	+	+	+	(+)	—
Ch. stellatus	+	+	+	(+)	—	—
B. tulipiformis	+	+	+	+	—	—
B. spongicola	+	+	+	+	—	—
P. anglicum.	+	+	+	+	—	—
M. pollicipes	+	+	+	—	—	—
P. minuta	—	+	+	(+)	—	—
B. a. amphitrite	—	+	+	+	—	—
B. calceolus	—	+	+	+	—	—
B. fallax	—	+	+	+	(+)	—
B. v. venustus	—	(+)	(+)	+	—	+
H. cornuta	—	—	+	(+)	—	—
O. lowei	—	—	+	+	—	—
B. pallidus	—	—	(+)	+	—	—
Ibla atlantica	—	—	—	+	—	—
S. renei	—	—	—	+	—	—
Ch. aestuarii	—	—	—	+	—	—
C. manati	—	—	—	+	—	—
Ch. dentatus	—	—	—	+	+	+
B. maxillaris	—	—	(+)	—	+	+
Totals	7	12	16	19	5	3
%	37	63	84	100	26	16

TABLE II. The northward and southward Atlantic distribution of 21 tropical West African barnacles.

of its range in an area the " plus " symbol for presence is placed in brackets thus (+).

The northern affinities of the West African cirriped fauna are obvious. Of the remaining 19 species occurring between Dakar and Lobito, Angola, and listed in the table below, 16 (84%) occur to the north of Dakar and 12 of these (63%) extend into the western Mediterranean. Only one species, *B. perforatus*, is known reliably from the Eastern Mediterranean. Although a second, *C. stellatus*, is recorded from there this may well be an error of identification. Seven species (37%) extend into S.W. Europe, with a few reaching the English Channel. On the other hand only 5 (26%) are known from S.W. Africa and 3 (16%) from the Cape.

ACKNOWLEDGMENTS

In completion of this final and at the present time comprehensive report on the barnacles of the West Coast of Africa it is a pleasure to repeat my thanks to those Directors of Museums or Institutions who have entrusted to me the cirripede collections in their charge: also to the many individuals who have assisted me, with specimens, identifications and otherwise. My especial thanks are due to the Director of the British Museum (Natural History) for continued access to the collections and library of the Museum and for agreeing to publish this present work. To the Keeper of Zoology of the Museum and members of his staff I tender my thanks for many kindnesses in identifying, or checking my identifications of, the hosts of many epizoic species, and otherwise. To Dr. J. P. Harding I owe personal thanks for permission to use his photographs of *K. discoporellae* reproduced in Pl. 1.

SUMMARY

1. The distribution of seventy species and varieties of barnacles, including five species of Acrothoracica in West Africa is recorded.

2. Two new species are described. *Ibla atlantica* sp. n. from the continental shelf off Sierra Leone represents the first record of this genus in the Atlantic. A new Acrothoracican, *Kochlorinopsis discoporellae* gen. et sp. n. has characters between *Kochlorine* and the Lithoglyptidae. It is referred to the latter family, for which a redefinition is given.

3. The type material of *Dichelaspis hoeki* Stebbing and *D. antiguae* Stebbing has been re-examined and compared with new material. The union of the two species as *D. hoeki* by Annandale (1910), followed by Nilsson-Cantell (1927) (as *O. hoeki* (Stebbing)) is rejected and *D. antiguae* is reinstated as a species, *O. antiguae* (Stebbing). It is not, as far as is known, found in the eastern Atlantic.

4. The forms *Balanus amphitrite communis*, *B. a. hawaiiensis* and *B. a. denticulata* as found in W. Africa, have been re-examined in the light of Harding's (1962) redescription of Darwin's type material. No constant differences could be detected on which to separate the varieties and they are united as *B. amphitrite amphitrite* Darwin.

5. Harding (1962) could not find constant differences for separating the two " *amphitrite* " varieties called by him *B. pallidus pallidus* Darwin and *B. pallidus stutsburi* Darwin. The latter name is reduced to a synonym and both white and coloured shells are referred to the species *B. pallidus* Darwin.

6. Amplified descriptions have been given of the following : *Chthamalus dentatus* Krauss, *C. aestuarii* Stubbings, *Balanus perforatus* Bruguière, *B. venustus venustus* Darwin, *B. fallax* Broch, *Tetraclita divisa* Nilsson-Cantell and *Chelonibia patula* (Ranzani).

7. The affinities of the West African barnacle fauna with those of South-west Europe, the Mediterranean and South Africa are discussed.

REFERENCES

Aguilar-Amat, J. B. de. 1927. Tres Cirrípedos de Africa occidental. *Butll. Inst. catal. Hist. Nat.* ser. 2, **7** : 126–127.

Annandale, N. 1906. Report on the Cirripedia collected by Professor Herdman at Ceylon in 1902. Rep. Pearl Oyster Fish. Gulf of Manaar Pt. 5, Suppl. Rept. **31** : 137–150.

—— 1910. Notes on Cirripedia Pedunculata in the collection of the University of Copenhagen. *Vidensk. Meddr. dansk naturh. Foren.* 3, (1910) : 211–218, pl. 3.

Aurivillius, C. W. S. 1894. Studien über Cirripeden. *Kongl. Svenska Vetensk.-Akad. Handl.* 26 no. **7** : 1–107, pls. 1–9.

—— 1898. Cirrhipèdes nouveaux provenant des campagnes scientifiques de S.A.S. le Prince de Monaco. *Bull. Soc. Zool. France* **23** : 189–198.

Barnard, K. H. 1924. Contributions to the Crustacean fauna of South Africa. 7. Cirripedia. *Ann. S. Afr. Mus.* **20** : 1–103, pl. 1.

—— 1925. Report on a collection of Cirripedia (Barnacles) from South African Waters. *Union of South Africa Fish. Mar. Biol. Survey Rept.* 4 (1925) *Special Rept.* No. **6** : 1–5.

Barnes, H. & Barnes, M. 1964. Répartition et écologie générale des Cirripèdes *Chthamalus depressus* (Poli) et *C. stellatus* (Poli) le long des côtes méditerranéennes d'Espagne et de France. *Bull. Inst. océanogr. Monaco* **62** (1299) : 1–19.

Bassindale, R. 1961. On the marine fauna of Ghana. *Proc. Zool. Soc. Lond.* **137** : 481–510.

Batham, E. J. 1945. Description of female, male and larval forms of a tiny stalked barnacle, *Ibla idiotica*, n. sp. *Trans. Roy. Soc. N. Zealand* **75** : 347–356, pls. 26–28.

Bishop, M. W. H. 1951. Distribution of barnacles by ships. *Nature, Lond.* **167** : 531.

—— Crisp, D. J., Fischer-Piette, E. & Prenant, M. 1957. Sur l'écologie des Cirripèdes de la côte atlantique française. *Bull. Inst. oceanogr. Monaco*, **54** (1099) : 1–12.

Borradaile, L. A. 1916. Crustacea, Part III, Cirripedia. *British Antarctic* (" *Terra Nova* ") *Exped.* 1910, *Nat. Hist. Rept. Zool.* **3** : 127–136.

Brian, A. & Dartevelle, E. 1954. Sur un cirripède pédonculé des côtes d'Angola : *Octolasmis lowei* (Ch. Darwin). *Ann. Mus. Congo belge n.s. 4to Zool.* **1** : 140–152.

Broch, Hj. 1922. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16. X. Studies on Pacific Cirripeds. *Vidensk. Meddr. dansk naturh. Foren.* **73** : 215–358.

—— 1924*a*. La faune des Cirripèdes de l'Afrique Occidentale d'après nos dernières connaissances. *Bull. Soc. Sci. Nat. Maroc* **4** : 202–205.

—— 1924*b*. Parasitologia mauritanica. Cirripedia. *Bull. Com. d'Études hist. sci. Afr. occid. Franç.* **7** : 559–579.

—— 1924*c* Cirripedia Thoracica von Norwegen und dem Norwegischen Nordmeere. Eine systematische und biologisch-tiergeographische Studie. *Skr. VidenskSelsk. Christiania Mat.-naturv. Kl.* 1924, (**17**) : 1–121, pls. 1–3.

—— 1927*a*. Studies on Moroccan Cirripeds (Atlantic Coast). *Bull. Soc. Sci. Nat. Maroc* **7** : 11–38, pls. 1–4.

—— 1927*b*. Cambridge expedition to the Suez Canal, 1924. VII. Report on the Crustacea Cirripedia. *Trans. Zool. Soc. Lond.* **22** : 133–138.

—— 1931. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16. LVI. Indomalayan Cirripedia. *Vidensk. Meddr. dansk naturh. Foren.* **91** : 1–146.

—— 1953*a*. Cirripedia Thoracica. *The Danish Ingolf-Expedition* 3, (**14**) : 1–16.

BROCH, HJ. 1953*b*. Cirripedia of the high Adriatic trawling grounds. Repts. M.V. " Hvar " cruises : researches into fisheries biology 1948–1949, **6** (3) : 1–6, 1 map. *Izuj. Inst. Oceanogr. Ribarstro, Split.*

BRUGUIÈRE, J. G., 1792, Histoire naturelle des vers, *Encycl. Method.* (*Zool.*) t. 1, i–xviii, 1–757.

BUCHANAN, J. B. 1957. Benthic fauna of the Continental Edge off Accra, Ghana. *Nature, Lond.* **179** : 634–635.

—— 1958. The bottom fauna communities across the Continental Shelf off Accra, Ghana (Gold Coast). *Proc. Zool. Soc. Lond.* **130** (1) : 1–56, pl. 1.

CAZIOT, E. 1921. Les Cirripèdes de la mer de Nice. *Bull. Soc. Zool. France.* **46** : 51–54.

CHEVREUX, E. & DE GUERNE, J. 1893. Crustacés et Cirrhipèdes commensaux des tortues marines de la Méditerranée. *Bull. Soc. Entom. France* (6) **13** : cxv–cxx.

COOK, P. L. 1965*a*. Polyzoa from West Africa : the Cupuladriidae (Cheilostomata, Anasca). *Bull. Br. Mus. nat. Hist.* (Zool.) **13** (6) : 189–227, pls. 1–3.

—— 1965*b*. Notes on some Polyzoa with conical zoaria. *Cah. biol. mar.* **6** : 435–454.

COSTA, O. G. 1838. Di alcuni Balanidi appartenenti al Regno di Napoli. *Atti R. Accad. Sci. Napoli* 5 (1844) (**2**) : 133–140, pl. 1, figs. 1–7.

DARWIN, C. 1851. *A monograph on the sub-class Cirripedia. The Lepadidae; or, pedunculated Cirripedes.* London, the Ray Society.

—— 1854. *A monograph on the sub-class Cirripedia. The Balanidae; The Verrucidae.* London, the Ray Society.

DAVADIE, C. 1963. *Étude des balanes d'Europe et d'Afrique.* Editions du Centre National de la Recherche Scientifique Paris : 146 pp., 55 pl.

EKMAN, S. 1953. *Zoogeography of the Sea.* London, Sidgwick & Jackson.

ELLIS, J. 1758. An account of several rare species of barnacles. *Phil. Trans. Roy. Soc. Lond.* **50** : 845–885, pl. 34, figs. 1–20A.

EVANS, F. 1958. Growth and maturity of the barnacles *Lepas hillii* and *Lepas anatifera. Nature, Lond.* **182** : 1245–1246.

FISCHER-PIETTE, E. 1936. Étude sur la biogéographie intercotidale des deux rives de la Manche. *J. Linn. Soc. Lond. Zool.* **40** : 181–272.

—— & PRENANT, M. 1956. Distribution des Cirripèdes intercotidaux d'Espagne septentrionale. *Bull. Centre Études Recherches Sci. Biarritz* **1** : 7–19.

——, —— 1957. Quelques données écologiques sur les cirripèdes intercotidaux du Portugal, de l'Espagne du Sud et du Nord du Maroc. *Bull. Centre Études Recherches Sci. Biarritz* **1** : 361–368.

GAULD, D. T. 1957. An annotated check-list of the Crustacea of the Gold Coast. I. Cirripedia. *J. West Afr. Sci. Ass.* **3** : 10–11.

GMELIN, J. F. 1788–93. *Systema naturae* Linn. ed. 13, aucta, reformata, cura, J. F. Gmelin. Lipsiae.

GRUVEL, A. 1900*a*. Sur quelques espèces nouvelles du genre *Scalpellum* provenant des dragages du Talisman. *Proc.-Verb. Soc. Sci. phys. nat. Bordeaux* 1900 : 51.

—— 1900*b*. Sur les espèces nouvelles du genre *Verruca* provenant du Talisman. *Proc.-Verb. Soc. Sci. phys. nat. Bordeaux* 1900 : 55.

—— 1902*a*. Cirrhipèdes. *Exp. Sci. " Travailleur " et " Talisman ".* 1–179, pls. 1–7.

—— 1902*b*. Revision des Cirrhipèdes appartenant a la collection du Muséum d'Histoire Naturelle. 1. Pédonculés. *Nouv. Archs Mus. Hist. nat., Paris* (4) **4** : 215–312, pls. 11–14.

—— 1903. Revision des Cirrhipèdes appartenant a la collection du Muséum d'Histoire Naturelle. 2. Operculés. I. Partie systematique. *Nouv. Archs Mus. Hist. nat., Paris* (4) **5** : 95–170, pls. 1–4.

—— 1905. *Monographie des Cirrhipèdes ou Thécostracées.* Paris.

—— 1907*a*. Étude des Cirrhipèdes du Musée de Cambridge *Bull. Soc. Zool. France* **32** : 162–165.

—— 1907*b*. Note préliminaire sur les Cirrhipèdes operculés recueillis par l'expedition subpolaire allemande du " Gauss ". *Bull. Soc. Zool. France* **32** : 104–106.

—— 1907*c*. Cirrhipèdes operculés de l'Indian Museum de Calcutta. *Mem. Asiat. Soc. Bengal.* **2** : 1–10, pls. 1, 2.

GRUVEL, A. 1910. Die Cirripedien der Deutschen Südpolar-Expedition 1901–1903. *Deutsche Südpolar-Exped.* 11, Zool. **3** (11) : 195–229.
—— 1912. Mission Gruvel sur la côte occidentale d'Afrique (1909–1910) et collection du Muséum d'Histoire Naturelle. Les Cirrhipèdes. *Bull. Mus. Hist. nat. Paris* **18** : 344–350.
—— 1920. Cirrhipèdes provenant des campagnes scientifiques de S.A.S. le Prince de Monaco (1885–1913). *Rés. camp. Sci. Monaco* **53** : 1–89, pls. 1–7.
HARDING, J. P. 1962. Darwin's type specimens of varieties of *Balanus amphitrite*. *Bull. Br. Mus. nat. Hist.* (Zool.) **9** : 271–296, pls. 1–10.
HENRY, D. P. 1959. The distribution of the *amphitrite* series of *Balanus* in North American waters : pp. 190–203, pls. 1–4 in : *Marine Boring and Fouling Organisms* ed. D. L. Ray, Seattle, Univ. Washington Press.
HIRO, F. 1935. A study of Cirripeds associated with corals occurring in Tanabe Bay. *Rec. Oceanogr. Works, Japan* **7** : 45–72.
—— 1936. Occurrence of the cirriped *Stomatolepas elegans* on a loggerhead turtle found at Seto. *Annot. Zool. Jap.* **15** : 312–320.
—— 1937. Studies on Cirripedian fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. *Mem. Coll. Sci., Kyoto Univ.*, B, **12** : 385–478.
—— 1939, Studies on the Cirripedian fauna of Japan IV. Cirripeds of Formosa (Taiwan) with some geographical and ecological remarks on the littoral forms. *Mem. Coll. Sci. Kyoto Univ.* B **15** : 245–284.
HOEK, P. P. C. 1883. Report on the Cirripedia collected by H.M.S. " Challenger " during the years 1873–76. *Rep. Sci. Res. H.M.S. " Challenger "* 1873–76, *Zoology* **8** (3) : 1–169, pls. 1–13.
JENNINGS, L. S. 1918. Revision of the Cirripedia of New Zealand. *Trans. N. Zealand Inst.* **50** : 56–63.
KAWAHARA, T. 1961. Regional differences in the composition of fouling communities in Ago Bay. *Rep. Fac. Fish. Prefect. Univ. Mie, Japan*, **4** : 65–80.
—— 1963. Invasion into Japanese waters by the European barnacle *Balanus improvisus* Darwin. *Nature, Lond.* **198** : 301.
KISCH, B. S. 1958. *Balanus tulipiformis* Ellis on the Atlantic coast of France and an unusual situation for *B. amphitrite* Darwin. *Nature, Lond.* **181** : 206–207.
—— 1959. *Balanus tulipiformis* Ellis on the Atlantic coast of France. *Nature, Lond.* **183** : 341.
KOLOSVARY, G. 1940. Beitrag zur Kenntnis der Variabilität von *Lepas anatifera* Linné. *Zool. Anz.* **132** : 289–292.
—— 1941*a*. Die an den Pfählen der Lagunen von Venedig lebenden Balaniden. *Annls. hist-nat. Mus. natn. hung.* **34** (*Zool.*) : 105–116.
—— 1941*b*. Die Formenkreise der Chthamaliden. *Zool. Anz.* **133** : 67–81.
—— 1942. Studien an Cirripedien. *Zool. Anz.* **137** : 138–150.
—— 1943*a*. Cirripedia thoracica in der Sammlung des ungarischen National-Museums. *Annls. hist.-nat. Mus. natn. hung.* **36** (*Zool.*) : 67–120.
—— 1943*b*. Morphologische Bemerkungen über *Balanus psittacus* (Molina) und *Balanus maxillaris* Gronovius. Die Verbreitung dieser Arten auf Grund der neuesten Angaben. *Annls. hist.-nat. Mus. natn. hung.* **36** : (Zool.) : 121–128.
—— 1944*a*. Die Balaniden des Golfes von Triest. *Redia* **30** : 32–42, pls. 1–3.
—— 1944*b*. A Földközi-tenger és Melléktengereinek Balanidái. *Tenger* **34** : 11–12.
—— 1951. Les balanides de la Méditerranée. *Acta Biol. Acad. Sci. Hung.* **2** (4) : 411–413.
KORSCHELT, E. 1933. Über zwei parasitäre Cirripedien, Chelonibia und Dendrogaster, nebst Angaben über die Beziehungen der Balanomorphen zu ihrer Unterlage. *Zool. Jahrb. Syst.* **64** : 1–40.
KRAUSS, F. 1848. *Die südafrikanischen Mollusken. Ein Beitrag zur Kenntniss der Mollusken des Kap- und Natal-landes und zur geographischen Verbreitung derselben, mit Beschreibung und Abbildung der neuen Arten.* Stuttgart.
KRÜGER, P. 1911. Beiträge zur Cirripedienfauna Ostasiens. *Abh. bayer. Akad. Wiss.*, 2 Suppl.-Bd., 6 Abh. : 1–72, pls. 1–4.

KRÜGER, P. 1927. Cirripedia Thoracica der Dänischen Gewässer. *Vidensk. Meddr. dansk naturh. Foren.* **84** : 11–16.

LEACH, W. E. 1818. A general notice of the animals taken by Mr. John Cranch during the Expedition. Appendix IV in : Tuckey, J. K. 1818, *Narrative of an expedition to explore the River Zaire usually called the Congo in South Africa in* 1816. London.

LLABADOR, F. 1937. Sur l'existence du *Pollicipes cornucopia* Leach sur le littoral de l'Ouest Algérien. *Bull. Stat. d'Aquicult. Pêche de Castiglione* 1935 (2) : 126–131.

LONGHURST, A. R. 1958. An ecological survey of the West African marine benthos. *Colonial Office, Fish. Publ.* no. **11** : 1–102.

—— 1962. A review of the oceanography of the Gulf of Guinea. *Bull. Inst. fr. Afr. noire* **24**A : 633–663.

MACDONALD, R. 1929. A report on some Cirripeds collected by the S.S. " Albatross " in the eastern Pacific during 1891 and 1904. *Bull. Mus. Comp. Zool. Harvard*, **69** : 527–538, pls. 1–3.

MONOD, TH. 1938. *Conchoderma auritum* (L. 1767) Olfers 1814 sur un *Ziphius* cf. *cavirostris?* G. Cuvier 1823. *Bull. Stat. d'Aquicult. Pêche de Castiglione* 1936 (1) : 201, 205–210.

MOORE, L. B. 1944. Some intertidal sessile barnacles of New Zealand. *Trans. Roy. Soc. N. Zealand* **73** : 315–334, pls. 46, 47.

NEU, W. 1935. *Balanus eburneus* Gould und *Balanus improvisus* Darwin als Bewuchs ausgehängter Platten im Goldenen Horn von Istanbul. *Zool. Anz.* **112** : 92–95.

—— 1939. Bermerkungen über einige balanomorphe Cirripedien der Istanbuler Gewässer. *Zool. Anz.* **125** : 209–219.

NEWMAN, W. A. 1960. Five pedunculate Cirripeds from the Western Pacific, including two new forms. *Crustaceana* **1** : 100–116.

NICKLÈS, M. 1950. *Mollusques testacés marins de la côte occidentale d'Afrique.* Manuel ouest-africain II. Paris, Lechevalier.

NILSSON-CANTELL, C.A. 1921. Cirripeden-Studien. Zur Kenntniss der Biologie, Anatomie und Systematik dieser Gruppe. *Zool. Bidr. Uppsala* **7** : i-ix, 75–390, pls. 1*–3*.

—— 1925. Neue und wenig bekannte Cirripeden aus den Museen zu Stockholm und zu Uppsala. *Ark. f. Zool.* **18**A, (3) : 1–46, pl. 1.

—— 1927. Some barnacles in the British Museum (Nat. Hist.). *Proc. Zool. Soc. Lond.* 1927, (**2**) : 743–790, pl. 1.

—— 1928. Studies on Cirripeds in the British Museum (Nat. Hist.). *Ann. Mag. Nat. Hist.* (10) **2** : 1–39.

—— 1930*a*. Thoracic Cirripedes collected in 1925–1927. *Discovery Reports* **2** : 223–260, pl. 1.

—— 1930*b*. Cirripedes. Résultats scientifiques du voyage aux Indes Orientales Néerlandaises. de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. *Mem. Mus. Roy. d'Hist. nat. Belg.* hors ser. **3** (3) : 1–24.

—— 1932*a*. Revision der Sammlung recenter Cirripedien des Naturhistorischen Museums in Basel. *Verhandl. naturf. Ges. Basel* **42** : 103–137, pl. 2.

—— 1932*b*. Cirripedien aus Japan. *Ark. f. Zool.* **24**A, (4) : 1–30, pl. 1.

—— 1933. Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930. No. 12. Cirripeds from Bonaire. *Zool. Jahrb. Syst.* **64** : 503–508.

—— 1934. Cirripeds from the Malay Archipelago in the Zoological Museum of Amsterdam. *Zool. Meded. Leiden* **17** : 31–63.

—— 1938*a*. Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. *Mem. Ind. Mus.* **13** : 1–81, pls. 1–3.

—— 1938*b*. Recent Cirripeds from the Congo. *Rev. Zool. Bot. Afr.* **31** : 175–181.

—— 1939*a*. Thoracic cirripedes collected in 1925–1936. *'Discovery' Rep.* **18** : 223–238.

—— 1939*b*. Résultats scientifiques des croisières du navire-école Belge " Mercator ". Cirripedia. *Mem. Mus. Roy. d'Hist. nat. Belg.* (2) **15** : 91–94.

—— 1939*c*. Recent and fossil Balanids from the north coast of South America. *Cap. Zool.* **8** (4^3) : 1–7.

NOLL, F. C. 1874. *Kochlorine hamata* N., ein bohrendes Cirriped. *Zeits. wiss. Zool.* **25** : 114–128, pl. 6.

NORMAN, A. M. & SCOTT, T. 1906. *The Crustacea of Devon and Cornwall.* London.
NORRIS, E. & CRISP, D. J. 1953. The distribution and planktonic stages of the Cirripede *Balanus perforatus* (Bruguière). *Proc. Zool. Soc. Lond.* **123** : 393–409.
OLIVEIRA, L. P. H. DE. 1940. Sobra uma nova especie de crustaceo *Chthamalus rhizophorae* n. sp. (Chthamalidae : Cirripedia). *Mem. Inst. Oswaldo Cruz* **35** : 379–380, pl. 1.
—— 1941. Contribuição ao conhecimento dos crustáceos do Rio de Janeiro, Subordem "Balanomorpha" (Cirripédia : Thoracica). *Mem. Inst. Oswaldo Cruz* **36** : 1–31, pls. 1–11.
OSTROUMOFF, A. 1892. Note sur la distribution de *Balanus eburneus* Gould. *Zool. Anz.* **15** : 160.
PILSBRY, H. A. 1907. The barnacles (Cirripedia) contained in the collections of the U.S. National Museum. *Bull. U.S. natn. Mus.* **60** : i–x, 1–122, pls. 1–11.
—— 1909. Report on barnacles of Peru, collected by Dr. R. E. Coker and others. *Proc. U.S. natn. Mus.* **37** : 63–74, pls. 16–19.
—— 1910. *Stomatolepas*, a barnacle commensal in the throat of the loggerhead turtle. *Amer. natn.* **44** : 304–306.
—— 1916. The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum ; including a Monograph of the American species. *Bull. U.S. natn. Mus.* **93** : i–xi, 1–366, pls. 1–76.
POPE, E. C. 1965. A review of Australian and some Indomalayan Chthamalidae (Crustacea : Cirripedia). *Proc. Linn. Soc. New South Wales* **90** : 10–77, pls. 1, 2.
REES, W. J. 1962. The distribution of the coral, *Caryophyllia smithii* and the barnacle *Pyrgoma anglicum* in British waters. *Bull. Br. Mus. nat. Hist.* (Zool.) **8** : 401–418, pl. 12.
—— 1966. Further notes on the distribution of *Caryophyllia smithii* Stokes and Broderip and *Pyrgoma anglicum* Sowerby *Ann. Mag. Nat. Hist.* (13) **9** : 289–292.
ROSS, A. 1965. Acrothoracican barnacle burrows from the Florida Miocene. *Crustaceana* **9** : 317–318, pl. 23.
SANDISON, E. E. 1954. The identification of the nauplii of some South African barnacles with notes on their life histories. *Trans. Roy. Soc. S. Africa* **34** : 69–101.
—— 1962. The populations of *Balanus amphitrite* var. *stutsburi* on the Guinea coast. *Proc. Zool. Soc. Lond.* **138** : 517–542.
SOURIE, R. 1954. Contribution a l'étude écologique des côtes rocheuses du Sénégal. *Mém. Inst. fr. Afr. noire* No. **38** : 1–342, pls. 1–23.
SOUTHWARD, A. J. & CRISP, D. J. 1954. The distribution of certain intertidal animals around the Irish coast. *Proc. Roy. Irish Acad.* **57**B (1) : 1–29.
STEBBING, T. R. R. 1895. Notes on Crustacea. Two new Pedunculate Cirripedes. *Ann. Mag. Nat. Hist.* (6) **15** : 18–22, pl. 2.
—— 1910. General catalogue of South African Crustacea. *Ann. S. Afr. Mus.* **6** : 281–599, pls. 15–22.
STUBBINGS, H. G. 1961*a*. Cirripedia Thoracica from Tropical West Africa. *Atlantide Report* **6** : 7–41.
—— 1961*b*. Cirripedia : Campagne de la *Calypso* dans le Golfe de Guinée et aux îles Principe, São Tomé, Annobon (1956). *Ann. Inst. Océan.* **39** : 179–192.
—— 1963. Cirripedia of the tropical South Atlantic coast of Africa. *Expéd. Océanogr. Belge dans les Eaux Côtières africaines de l'Atlantique Sud* (1948–1949) *Rés. Sci.* **3** (10) : 1–39.
—— 1964*a*. Cirripedia. Campagne de la "Calypso" aux îles du Cap Vert (1959) *Ann. Inst. Océan.* **41** : 103–112.
—— 1964*b*. Cirripedia from the Congo Estuary and adjacent coasts in the Musée Royal de l'Afrique Centrale, Tervuren, Belgium. *Rev. Zool. Bot. Afr.* **69** : 327–347.
—— 1965, West African Cirripedia in the collections of the Institut Français d'Afrique Noire, Dakar, Senegal. *Bull. Inst. fr. Afr. noire* **27**A (3), 876–907.
STUDER, T. 1882. Verzeichnis der während der Reise S.M.S. Gazelle an der Westkuste von Afrika, Ascension und dem Cap der Guten Hoffnung gesammelten Crustaceen. *Abh. K. Akad. Wiss. Berlin* 1882, Abh. 2 : 1–32, pls. 1, 2.

STUDER, T. 1889. *Die Forschungsreise S.M.S. Gazelle in den Jahren 1874 bis 1876.* 3 Theil. Zool. u. Geol. 322 p. 33 pl. Herausg. hydrogr. Amt d.Reichs-marine-Amts, Berlin.

TARASOV, N. I. & ZEVINA, G. B. 1957. [Cirripedia Thoracica of the seas of the S.S.S.R.] *Fauna SSSR Crustacea* 6 bd. 1, 1–267 : *Zool. Inst. Akad. Nauk, SSSR* n.s. no. 69.

TEBBLE, N. 1955. The Polychaete fauna of the Gold Coast. *Bull. Br. Mus. nat. Hist.* (Zool.) **3** : 59–148.

TOMLINSON, J. T. 1960. *Cryptophialus coronatus*, a new species of Acrothoracican barnacle from Dakar. *Bull. Inst. fr. Afr. noire* **22**A : 402–410.

—— & NEWMAN, W. A. 1960. *Lithoglyptes spinatus*, a burrowing barnacle from Jamaica. *Proc. U.S. Nat. Mus.* **112** : 517–526.

UTINOMI, H. 1949. Studies on the Cirripedian fauna of Japan. VI. Cirripeds from Kyusyu and Ryukyu Islands. *Publ. Seto Mar. Biol. Lab.* **1** : 19–37.

—— 1950. A new remarkable coral-boring Acrothoracican Cirriped. *Mem. Coll. Sci. Kyoto Univ.* B, **19** : 87–94, pl. 1.

—— 1958. Studies on the Cirripedian fauna of Japan VII. Cirripeds from Sagami Bay. *Publ. Seto Mar. Biol. Lab.* **6** : 281–311.

—— 1959*a*. Thoracic cirripeds from the environs of Banyuls. *Vie et Milieu* **10** : 379–399.

—— 1959*b*. Cirripedia Thoracica from the Western Mediterranean. *Vie et Milieu* **10** : 400–404.

—— 1960*a*. On the world-wide dispersal of a Hawaiian barnacle, *Balanus amphitrite hawaiiensis* Broch. *Pacif. Sci.* **14** : 43–50.

—— 1960*b*. Studies on the Cirripedia Acrothoracica. II. Internal anatomy of the female of *Berndtia purpurea* Utinomi. *Publ. Seto Mar. Biol. Lab.* **8** : 223–279, pls. 31–33.

—— 1963. Studies on the Cirripedia Acrothoracica. IV. Morphology of the Female of *Balanodytes taiwanus* Utinomi. *Publ. Seto Mar. Biol. Lab.* **11** : 57–73, pl. 1.

VÉRANY, J. B. 1862. *Zoologie des Alpes-Maritimes ou catalogue des animaux observés dans le département.* (Extrait de la Statistique générale du département—J. Roux.) Nice.

WEISS, C. M. 1948. The seasonal occurrence of sedentary marine organisms in Biscayne Bay, Florida. *Ecology* **29** : 153–172.

WELTNER, W. 1887. Die von Dr. Sander 1883–85 gesammelten Cirripedien (*Acasta scuticosta* sp. n.). *Arch. Naturgesch.* Jahrg. **53**, Bd. 1 : 98–117, pls. 3, 4.

—— 1897. Verzeichnis der bisher beschriebenen recenten Cirripedienarten. *Arch. Naturgesch.* Jahrg. 63 Bd. **1** : 227–280.

—— 1922. Cirripedia der Deutschen Tiefsee-Expedition. *Wiss. Ergebn. Deutsche Tiefsee-Exped.* **23** (2) : 59–112, pls. 2–4.

WILLIAMS, G. 1954. Fauna of Strangford Lough and neighbouring coasts. *Proc. R. Irish Acad.* **56**B : 29–133, pls. 2–4.

WOOD, E. J. F. & ALLEN, F. E. 1958. *Common marine fouling organisms of Australian waters.* Dept. of the Navy, Melbourne, Australia.

ZEVINA, G. B. & TARASOV, N. I. 1954. [Acorn barnacles new to Soviet Waters of the Black Sea.] *Trudy sevastopol'. biol. Sta.* **8** : 341–346.

—— 1963. [Cirripedia Thoracica of the mainland coasts of south-east Asia.] *Trudy Inst. Okeanol.* **70** : 76–100.

PLATE 1

Kochlorinopsis discoporellae g. et sp. n.

a. Frontal view of a specimen of a host Polyzoan *Discoporella umbellata* (Defrance) with a number of embedded *K. discoporellae* ×4.

b. Basal view of the same after decalcifying with diluted hydrochloric acid so that the embedded cirripedes of various sizes can be seen ×4.

c. A recently settled specimen of *K. discoporellae* photographed by transmitted light showing the paired antennules lying against the dorsal side of the mantle ×54.

A

B

C